DESIGN, DEPLOYMENT, IDENTITY, & CONFORMITY:

AN ANALYSIS OF CHILDREN'S ONLINE SOCIAL NETWORKS

A Dissertation

by

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ABSTRACT

Preadolescents (children aged 7 to 12 years) are participating in online social networks whether we, as a society, like it or not. The Children's Online Privacy Protection Act, enacted by the United States Congress in 1998, made illegal the collection of online data about children under the age of 13 without express parental consent. As such, most mainstream social networks, such as Twitter, Facebook, and Instagram, limit their registration by requiring new users to agree that they are at least 13 years of age, an assertion which is often falsified. Researchers, bound by the same legal requirements regarding online data collection, have resorted to surveys and interviews to understand how and why children interact on social networks. While valuable, these prior works explain only what children *say they do* online, and not what they *actually do* on a daily basis. In this work, we describe the design, development, deployment, and analysis of our own online social network for children, KidGab. This work explores common social networking affordances for adults and their suitability for child audiences. It analyzes the participatory behaviors of our users (Girl Scouts from around central Texas) and describes how they shaped KidGab's continuing growth. This work discusses our quantitative analysis of users' tendencies and proclivities toward identity exploration leverages graph algorithms and link analysis techniques to understand the sociality of conformity on the network. Finally, this work describes the lessons we learned about children's social networks and social networking throughout KidGab's 450 days of active deployment.

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1 INTRODUCTION

Children seem to become more technically savvy each day — in many cases they far surpass the skills and knowledge of their parents and teachers. However, children lack the maturity to navigate an Internet that was built for adults and for adult content, particularly in the realm of online social networking. In 2012, Chelsea Clinton succinctly summed up the challenges facing the intersection of children, digital media, and social networking today:

> "By the time [children are] 2 years old, more than 90% of all American children have an online history. At 5, more than 50% regularly interact with a computer or tablet device, and by 7 or 8, many children regularly play video games. Teenagers text an average of 3,400 times a month. The fact is, by middle school, our children today are spending more time with media than with their parents or teachers, and the challenges are vast: from the millions of young people who regret by high school what they've already posted about themselves online to the widely documented rise in cyberbullying." [35].

Along a similar vein, in 2010, Microsoft Corporation conducted a series of surveys to study security issues surrounding children on social networks. According to one survey, 38% of children under the age of 13 have a social networking profile, and 84% of those children have accounts with a minimum age requirement of 13 years [138]. It is clear that children are engaging in social networking activities at an early age, regardless of legality.

In another 2010 survey, Microsoft found that 40% of parents said their child was involved in a cyberbullying incident. In the same survey, Microsoft reported that 76% of educators now rank cyberbullying as a "severe" issue. Drugs and smoking was ranked as "severe" by only 75% of educators.

Clearly these surveys, as well as scientific work done by numerous other researchers (i.e. [27, 3, 73, 102]) include an explicit or implicit call to action: Someone must do something to protect our children online! The work we present here attempts to "do something" about a small piece of this problem — namely protecting children on social networking sites. As we explain in greater detail in Chapters 2 and 3, many commercial ventures claim to have a similar goal, but focus more on restrictions than free communication and practice. As a result, children never get to practice how to freely operate within a social network where they can actually communicate with other people.

In this research work, we designed, developed, and deployed a social network for children that provides freedom of communication with the *addition* of monitoring, rather than the *restriction* of expression. We have collected data using this social network and report findings regarding conformity, participation, identity, expression, and parental engagement on social networks for children, as well as an evaluation framework of design principles which describe best practices for designers of social networks for children.

1.1 Research Questions

In this work, we answer five specific research questions:

1. How should social networking designers build online social networking affordances for child users?
2. What are the detailed affordances and functionalities of a system built upon those design principles?
3. How do children adopt and reuse the ideas of others on online social networks for children?
4. What roles do gamification, personality quizzes, and identity exploration play in the participation rates of children on online social networks?
5. Following more than a year of deployment, what have we, as children's social network designers and administrators, learned about creating and maintaining an online social network for children?

1.2 Manuscript Overview

In the following chapters, we discuss prior work; how our work differs from and was inspired by the existing; we will provide a tour through our custom social network, KidGab; we will describe our data collection procedures, outline methodologies to answer our research questions; and finally, we will summarize the contributions of our work.

2 LITERATURE REVIEW

In this chapter, we first present general research regarding the risks and benefits of social networking for children. Then we present existing social networks from both commercial and research sectors, the interaction methods they employ, and the design features intended to protect users from cyberbullying or other cyberthreats. Next, we briefly discuss prior works in the tangential but relevant area of sketching in childhood. Finally, we discuss what sets this proposed work apart from the sum of other works presented in this chapter. Further and more specific discussions of prior work, particularly on social networking affordances for children, identity exploration, and conformity, continue throughout the remaining chapters of this manuscript. Additionally, Appendix A presents a multi-national meta review of literature surrounding middle school cyberbullying.

2.1 Social Networking for Children

Bauman and Tatum define social networking as the co-creation of interactive communications, by the users and by the platform [12]. Each social network allows (and restricts) different styles of communications and thus can be considered an actor in the creation process. Twitter[1], for example, is a micro-blogging site that allows the use of only 140 characters per post. Instagram[2] only allows the dissemination of perfectly square images. Many social networks meant for children only allow pre-scripted communications

[1] http://www.twitter.com
[2] http://www.instagram.com

to be exchanged [12]. Thus, interaction designers for new social networks need to be both considerate and deliberate in the types of communications that they will support.

Most mainstream social networks such as Facebook[3], MySpace[4], Twitter, etc. have minimum age restrictions of 13 years. These restrictions are in keeping with federal laws (namely, the Children's Online Privacy Protection Act, or COPPA), which restrict websites from gathering or keeping information about children under the age of 13 without parental permission. Because of the age restriction, often the content of the site is not appropriate for children younger than 13. Many children and parents disregard this restriction and register with falsified age information [138]. This falsification is not only dangerous due to the mature content of the site, but it could send mixed messages to the child that lying on the Internet is acceptable behavior [144].

O'Keeffe and Clarke-Pearson [144] present the major benefits and risks of social networking for children from a pediatrician's perspective. According to O'Keeffe and Clarke-Pearson, the benefits of social networking for children and teens are: community engagement, growth of ideas, the opportunity to foster one's individual identity, and "the enhancement of individual and collective creativity through the development and sharing of artistic and musical endeavors" [144, p. 801]. Kaur et al. [85] offers a researcher's perspective. The authors identify the major benefits of social networking for children to include: the growth of "social capital" gained through participation, which strengthens their commitment to the community; the positive engagement from children who have

[3]http://www.facebook.com
[4]http://www.myspace.com

difficulty socializing openly in non-digital spaces; and the positive gains to adolescent well-being that come from interacting with friends in online applications, such as instant messaging.

The risks of social networking include cyberbullying (intentionally communicating false, embarrassing, or hostile information about another person using digital media) [117], sexting (sending, forwarding, or receiving messages, photographs, or other media that are sexually explicit in nature) [140], and Facebook depression (symptoms of depression that develop after prolonged use of social networking sites) [144]. Other risks include communications from persons with falsified identities, exposure to incorrect or misleading information, age-inappropriate advertisements, and the lack of positive gains to well-being children experience while talking to strangers online [85].

Though these risks are undeniable, the problems cannot be resolved by simply forbidding children from engaging in social networking activities. Children in the age group of discussion in this work (roughly ages 7 to 13) spend more time communicating with peers and friends than they spend with any other single activity [111]. The advent of social media to children's social circles means that children can now be "friends forever," even after friends are separated by time or geography [34].

Many children adopt different personas (i.e. adopting a 'gangsta rap' style of language) while participating in online social media sites. The children recognize these personas are not a true reflection of themselves, but they see this digital identity as a token to play with and manipulate as they undergo developmental and personality changes [34]. In

sum, participating in social media allows children to take the reins of their own personal development, a responsibility children embrace steadfastly [34, 18].

2.2 Existing and Previous Social Networks for Children

2.2.1 Commercial Sites & Applications

Very few researchers have explored social networking for children, but several commercial ventures are available or have been available for children to experience social interactions online.

For example, Club Penguin[5] is an all-encompassing online entertainment site for children, owned by The Walt Disney Company. On Club Penguin, children can play games, earn currency, create avatars, buy special clothing, collect pets, build igloos, and socialize with other users. To socialize with other users, children can choose between pre-approved messages, but cannot freely author content. Membership to the site costs a minimum of $5 per month.

Kuddle[6] is a free, cross-platform mobile app that allows children to post pictures and captions to their own page, sketch on images they've taken, 'friend' other users, and 'like' images posted by other users. Kuddle has several restrictions in place to prevent cyberbullying: users are required to use their own full name, they cannot comment on photos posted by other users, and once a friendship is created, it cannot be dissolved.

Togetherville[7] was a social network intended to unite children with their own com-

[5] http://www.clubpenguin.com
[6] http://www.kuddle.com
[7] formerly http://www.togetherville.com

munity of family and adults. Togetherville allowed children and their families to play games, post videos, share artwork and chat with other children. The chat functionality disallowed any direct authoring in favor of providing the user choices of prescreened text as an effort to prevent cyberbullying. Real identities were required as anonymity was considered by the designers to be another threat to cyberbullying. Each child's account was attached to his or her parent's Facebook account. In 2011, Togetherville was purchased by The Walt Disney Company, and in 2012, the site was taken off-line.

Skid-e-Kids[8] was a social network very resemblant to Facebook. Users could create profiles, design avatars, watch movies, participate in homework help and special interest forums, buy and sell toys, and play video games. Children registered for the site via a connection to a parent's Facebook profile. Parents and teachers can also register for the site and participate in adult and educational forums. The site was free to use. In 2011, the creators of Skid-e-Kids faced Federal Trade Commission charges for violating the Commission's Children's Online Privacy Protection Act ("COPPA") Rule by obtaining personal information about minors under the age of 13 without express parental consent. Skid-e-Kids is no longer operational.

SuperClubsPLUS3[9] is an organization-specific social network targeted toward schools and school districts. Two versions of the site are available, one for primary-aged children and one for middle-school-aged children. Members of the site can create profiles, post blog entries, upload images, participate in forums, make friends, share events, create

[8] formerly http://www.skidekids.com
[9] http://www.superclubsplus.com/

educational wikis and pages, and participate in polls and surveys. Each of these functions can be enabled or disabled by site (school) administrators. Users are registered manually by organizational administrators. Subscription to the site costs the organization between £300 and £800 per year, and subscribers must deploy the site on their own servers.

KidzWorld[10] is a social networking site which allows children aged 9-16 to participate in forum discussions, chat in chat rooms, and share original content including blogs, stories, and poetry. KidzWorld is moderated using swearword detection and behavioral analysis technology. KidzWorld is still online and very active, but data logs recently shared with our research team of the site's chat rooms reveal that inappropriate content runs rampant in KidzWorld's digital community. Of the more than 68,000 chat messages we analyzed, we found 2,233 posts that included inappropriate words, mature themes, and/or cyberbullying: that amounts to 3.26%, or about 1 in every 33 messages. Moderation occurs much too late to prevent such unwanted information from spreading.

WoogiAcademy[11] is a school-based learning platform that allows children to learn through video games, join clubs, create avatars, and play games with friends. It is unclear whether WoogiAcademy users can actually freely communicate with one another, but the social gaming aspect qualifies it as a social network.

2.2.2 Research: Technology-Assisted Communication Among Children

Winn [217], a researcher in educational technology, instituted a monitored children social network similar to the one we propose at a small private middle school in Fort Worth,

[10] http://kidzworld.com
[11] http://www.woogiacademy.com/

TX. Winn's site, Eaglespace, is based on the generic social networking site builder Social Engine (http://socialengine.com). Eaglespace is specifically geared toward teaching digital citizenship. Aside from monitoring, his site includes basic social networking features such as wall posts, status updates, image upload, groups, etc. Parents are not included in the site membership, but teachers and administrators provide monitoring.

Inkpen et al. [76] created a social network, VideoPal, for children (ages 9-11) that allowed for asynchronous video communication. The experimental users of VideoPal were very enthusiastic about asynchronous video as a communication channel and preferred it over SMS textual communications.

Abeyrathne [1] presented Petimo, a social network based on small, pet-like robots. Friendships need to be phyisically authenticated by tapping two robots together, adding to its safety. Communication among friends includes emoticons, gifts, high fives, and handshakes.

Joshi and Walsh [81] engaged in cooperative inquiry to design a social networking application, called Twooter. Twooter was designed to allow for children and adults to communicate non-verbal musical compositions on an online social network. Once composed, these Twoots ideally would be be saved and shared on a social-network-like status feed.

Raffle et al. [158] created three applications for asynchronous family communication by preschoolers. The physical devices for each application resemble a jack-in-the-box or a toaster. The toaster-like device has a cell phone that pops out of the top when a specific button on the outer shell is pressed. Children can take pictures, videos, and browse family

photographs using physical token artifacts. Along a similar vein, Näsänen et al. [143] built a system to allow mobile media communication (images and videos) between children, teachers, and parents at a kindergarten (in the United States, we call this a daycare).

Very early work (before the advent of camera phones) by Mákelá et al. [124] sought to understand how and why children communicate through digital photographs sent via wireless devices in every day life. Mákelá found that images were mainly used for sharing jokes, expressing emotions, and creating art.

2.2.3 Interaction Methods in Children's Social Networking

As mentioned in Section 2.2.1, many social networks built for children constrain text-based communication to pre-written (adult-authored) communications (i.e. Club Penguin). Many others attempt to prevent cyberbullying, harassment, and inappropriate topics through the use of blocked word lists (i.e. KidzWorld). These dictionaries contain swear words, sexually explicit words, violent words, etc. Many children find ways to work around these restrictions, however.

Some social networking sites for children provide the ability to customize their own online environments, such as the customizable igloo in Club Penguin or the clothing choices provided for avatars on numerous sites. These allow for customization and creativity, but only via the selection of premade objects.

2.2.4 Methods for Protecting Children on Social Networks

As described above, most of the existing or previous social networks for children made great concessions in their social networks in order to prevent cyberbullying and other

threats. For example, Kuddle and Togetherville force children to use their own names when registering, in order to prevent the anonymity that fosters fears of cyberbullying (but in truth most cyberbullying is not anonymous [139]). Other concessions made by children's social media designers include: preventing the dissolution of friendships, disallowing comments, 'wall posts', and/or status updates, restricting conversation by only allowing pre-approved texts and emoticons, charging membership fees, etc. These dis-allowances indeed prevent cyberbullying, but they also impede safe and healthy digital friendships from forming or growing. Nearly all of these social networks claim to be a training ground for online social networking, yet many inherently prevent the social individuality and the free-flow of ideas (for better or for worse) that so epitomize adult social networks today.

A few social networks, namely KidzWorld, rely on user-moderators, users who have shown good behavior and are given the power and responsibility to enforce the site's community standards. Though this is effective in many adult sites (such as StackOverflow[12]), the varying and often limited schedules of children make it difficult to have a moderator in every chat room and forum at any given moment.

Many social networks for children listed above require parents and/or teachers to moderate the site. Winn explained the success of teacher-moderation in the maturation of safe social networking habits:

> "Just as a teacher would take the time to discuss appropriate behavior in a classroom or cafeteria, they also make the effort to discuss online behavior.

[12]http://www.stackoverflow.com

> One example was a young lady who posted that she and her friends "partied all night long," referring to an innocent and perfectly appropriate sleepover with her friends. We were able to help her see the connotations associated with that phrase and explained that it could negatively misrepresent her and our school." [217, p. 13]

Beyond monitoring of and restrictions for children's interactions online, several researchers have proposed solutions to specific cyberthreats. For example, Mazari [131] proposes four-dimensions of approaches to combat cyberbullying: technology, awareness and education, psychological, and administrative. Within the technology-oriented approach, Mazari recommends: spam blockers, parental controls, IP-address-tracking, and [unknown people] who need to work with social media designers to make it easier to report incidents of cyberbullying. Mazari also advocates for workshops for children, which focus on coping strategies, as well as workshops for parents, which should focus on technological awareness [131].

Other similarly-motivated researchers include Rybnicek et al. [173], who propose a Watchdog system to identify sexting, cyberbullying, and grooming through a system made up of image/video analysis, social media analytics, and text analysis; Zakaria [221], who questioned parents about the design of a rule-based privacy setting recommender for children of varying ages; and de la Cruz [39], who proposes a design for a tool to detect child pornography in peer to peer networks. Yin et al. [219] and McGhee et al. [134] work to identify cyberbullying and online predation using word frequency, word sentiment, and

contextual features. Dinakar et al. [41] proposed a system that enforces waiting periods before posting when it detects ill sentiment in a communication. This proposed system also combines many cyberbullying posts into themes (such as homosexuality and prom) and alerts moderators of the trending issues. WoogiAcademy (a venture of WoogiWorld, mentioned above) [13] effectively teaches digital citizenship themes through a series of video games [72].

We have created a system that can recognize the age, gender, and birth month of a social networking user based on the style of the posts authored by that user. This can be used to catch users lying about their identities (or omit demographic information all together) on their social networking profiles. This work is currently under review. For more information about this research, see Appendix B.

2.3 What Do Children Talk About Online?

Though several social networks for children exist (or existed) there is still very little published research on what children actually talk about on online social networks. Inkpen et al. [76] indicated that the users of VideoPal discussed topics like homework, what they ate for dinner, and other insights into their daily lives. Winn [217] reported that children discussed the fun activities they participated in over weekends. However, outside of anecdotal mentions of discussion topics, few works have investigated the topics of digital conversations among children.

Of course, nearly all works that study cyberbullying victimization and perpetration

[13] http://www.woogiacademy.com

(i.e., [117, 73, 180]) answer a small piece of this puzzle, but all of them do so via questionnaires or interviews only. Questionnaires and interviews require self-reporting, and are based on the participant's perception of reality, rather than the truth. For example, Mishna et al. [139] found in interviews with children that many *fear* the anonymous nature of cyberbullying more than anything else, but *reported* mostly cyberbullying instances within groups of friends or known social circles. While there is great knowledge to be gained through questionnaires, there is also a great need for direct observation, which is one of the major contributions of this proposed work.

2.4 Sketching in Childhood

Drawing is a form of visual communication which has great potential to enrich the social networking experience for children. Drawing has long been considered a pre-writing skill. Developmentally, children can distinguish between the written word and pictures or drawings by three years of age [112]. By 4 or 5 years old, children can distinguish a written sentence from a string of letters and pictures arranged together in a straight line [108]. Around 4 years of age, children are also able to draw pictures to represent objects [57] and becoming increasingly sophisticated between five to eight years of age in using drawings to communicate what they know about objects [198]. Although writing and drawing are two distinct communication processes, children often demonstrate abilities to communicate through drawings earlier than through writing. Furthermore, when children are asked to write a letter or write to make personal reminders, children often mix or combine writing

and drawing. Thus, drawing remains an important form of communication even for older children who already know how to use writing as forms of communication.

2.4.1 Drawing Through Development

Since we will be investigating creative conformity of children using sketches, we discuss drawing throughout the stages of child development. Children go through many different stages of drawing development. According to Church [31], between the ages of 1 and 2, children experience the scribbling stage, in which the child may not understand the cause and effect of their movements and may not even look at the page as they scribble. Children of ages 3 and 4 experience the pre-symbolism stage, in which they become more precise in their actions and enjoy repetitive shape-making. At this stage, children can draw shapes such as circles, spirals, and lines, and possibly squares, rectangles, and ellipses. Children of ages 5 to 6 experience the symbolism stage. In this stage, children begin to draw representations of real-world objects, and favorite subjects include self-portraits, family, house, pets, vehicles, and nature. These more mature children have control of the size and direction of lines and their work begins to reflect their individual personalities [31].

Levick [114] calls the stage between ages 4 and 7 the sentence-picture stage because children are able to author simple sentences and illustrate them with an increasing level of detail. By ages 7 to 11, Levick claims that children enter the fact-fantasy stage. In this stage, children's drawings begin to include facts about people, places, and things in their environment. These facts allow children to draw more realistically, but also allow them to reach beyond fact and draw fantastical images depicting intentionally unrealistic scenes.

Drawings of children at this age closely reflect their feelings, observations, and fantasies.

According to Cox [37], by the age of 11 or 12, children have been taught the parallel oblique system in school art classes. This is the system that allows children to draw realistic-looking cubes, tables, etc. These children may allow this structure to appear in every drawing of box-like objects, whether or not the perspective is appropriate [37]. This indicates that children of this age are now attempting to draw as they are taught by adults rather than by their imaginations alone. Further, Levick [114] states that by age 11, children begin to cope with life in a more adult-like way and many stop drawing. Cox suggests that children older than 11 or 12 stop drawing because their expectations for realism are believed to be unreachable. Only those that have been singled out for exceptional talent in their artistic pursuits are encouraged to continue artistic training. For these reasons, we aim to recruit children between the ages of 6 and 11 to participate in our studies.

2.4.2 Benefits of Drawing for Children

Levick suggests that drawing can provide a lens into the emotional and rational development of a child. Many qualities of a child's drawing can give indications that a child is struggling emotionally or developmentally, such as the placement of the ground line, the orientation of a chimney on a house, and items seeming to be falling due to improper use of horizontal or vertical lines [114].

Goodnow [59] suggests that drawing is beneficial for children because it prepares them for a world where a great deal of thinking and communication is done visually and not through words alone, despite the great emphasis on words by the education system. The

emphasis on words is likely as strong now as it was in 1977, though we now live in a world of multimedia. From Facebook photo albums to YouTube video channels, it is important to understand the representational schemas (stick figures, houses as a square and triangle, etc.) that are learned by early drawing experiences.

Drake and Winner [43] have found that creative drawing has emotional regulating effects. In their study, children were asked to recall and focus on a disappointing event and then were asked to either illustrate that event, draw a house, or copy drawings of simple objects such as a teapot or toaster. Drake and Winner presented the children with faces ranging from very sad to very happy and the children were asked to indicate their mood both before and after the drawings. They found that only the creative drawing (the house) condition statistically improved the children's mood.

Karczmarzyk [84] discusses drawings in terms of the Gestalt Principle: the whole is greater than the sum of its parts. In the case of drawings, Karczmarzyk found that drawings themselves convey more information that the words used to describe them. Thus, drawings can be a richer communication space than text for certain types of communications. Karczmarzyk also suggests that erasing part or all of a drawing can contribute to communicative barriers between the sender and the recipient, so in the development of our system, we integrated a temporal element. Sketches are presented to the recipient in the way they are drawn (strokes, erasures, color changes, etc.) so that no data is lost.

2.4.3 Sketch Recognition Features of Children's Drawings

Many educational psychologists manually analyze children's sketches to assess their developmental progress. The disadvantages of manual assessment are that it is time-consuming and prone to human error and bias. This problem lends itself to sketch recognition as a solution. Unfortunately, current sketch recognition techniques concentrate solely on recognizing the meaning of sketches, rather than the sketcher‘s developmental skill; and do not perform well on children's sketched input, as most are trained on and developed for adult-drawn sketches. Researchers in the Sketch Recognition Lab at Texas A&M University developed a specialized sketch classification technique which utilizes a sketching interface for assessing the developmental skills of children from their sketches [209, 90, 91, 89, 92, 93]. The approach relies on sketch feature selection to automatically classify the developmental progress of children's sketches as either developmental or mature.

In order to determine the significant sketch features for building our age and gender classifiers, we first gathered 725 sketch data samples from twenty children (i.e., preschoolers ages 3-4 and grade schoolers ages 7-8) and 4 adults. With our collected data, we first extracted 130 state-of-the-art features used in geometric- and gesture-based recognizers (e.g., [54, 71, 122, 151, 170] , then found the optimal subset of these features using Weka [64]. Those optimal features were analyzed by several conventional machine learning algorithms using 10-fold cross-validation to classify the children's developmental progress and gender. From our work, we successfully distinguished preschool sketchers from more

mature sketchers (i.e., grade schoolers and adults) with an f-measure of .904. We then removed the adult sketchers to distinguish between preschoolers and grade schoolers to obtain an f-measure of .827. Finally, we distinguished the genders of the grade schoolers with an f-measure of .728. The results of evaluating KimCHI's gender classification revealed potential gender differences: existing primitive shape recognizers improved recognition accuracy when recognizing girls' sketches (i.e., 88.5%) compared to boys' sketches (i.e., 77.8%) using the Hausdorff recognizer [203, 52, 208, 207, 7, 205].

2.5 What Sets this Research Apart

We agree with Mazari [131] that workshops for children and parents about cyberbullying and other cyberthreats are necessary, and our proposed research plan includes both, but we think an additional technological solution is necessary: that of active, supervised practice with social networking.

As described throughout this chapter, several commercial social networks for children exist (or have existed) on the market. However, through the restrictions intended to protect children on many of the social networking sites mentioned above (disallowing dissolution of friendships, disallowing comments, restricting communication to prescreened messages, etc.), these sites do not prepare the children for the freedom and temptations that adult social networking sites hold. Some sites, such as Togetherville and Skid-e-Kids provided a very adult-like social networking experience, but both have been shut down. Kidzworld provides great freedom to the children on the network, but the multitude of

users combined with the unreliable human moderation and behavioral analysis technology allow children to post and view very inappropriate content. EagleSpace [217] is a great example of a monitored social network within a small group of children, however parents were not allowed to be stakeholders in the system, and the system was intended for middle-school children, rather than the young children (ages 7-13) that this research studies.

To conduct this research, we have designed and built KidGab, a custom social network for children. The design of KidGab includes many novel features, including the sketch and sketch-playback interaction modalities, the parental monitoring plugin, and the training workshop which precedes KidGab's use.

With the many other examples of social networks for children, we do not claim the design or fundamental existence of KidGab to be novel. However, though many commercial social networking sites exist for children, none have been directly *observed* by researchers to determine what children talk about, how their ideas flow throughout the network, or what makes a network successful. Additionally, each social network presented in this chapter (including KidGab) makes design decisions to prevent cyberbullying in seemingly opposite ways. It is important for us to investigate the psychological and educational foundations and implications of each design decision to determine appropriate design principles for a social network for children. These are the gaps in published research that this work fills.

3 AFFORDANCE CONSIDERATIONS FOR CHILDREN'S SOCIAL NETWORKING SITES

As new CSNSs (Children's Social Networking Sites) emerge, many claim to include features or restrictions intended to keep children the most safe, provide the most entertainment, or provide any other feature better than any CSNS on the web. With such a wide range of applications, one would expect to find great variances in fundamental design decisions. The variances within this group, however, deliver seemingly opposite decisions with nearly identical motivations. For example, some sites (e.g. Kuddle, Togetherville) require children to register with their legal names in order to protect children from cyberthreats, while others (e.g. Club Penguin, Kidzworld) require anonymous usernames for similar reasons. Some sites explicitly require parental interaction, while others explicitly exclude parents. Some restrict communication to pre-approved scripts, while others provide open forums for free communication. All claim to be child-appropriate, but which decisions are optimal?

In this chapter, we present a framework of design principles and best practices to answer such questions. In the framework, we explore ten constructs of online social networks organized into five themes (Identity, Communication Modalities, Community, Security, and Engagement). For each construct, we explore published research from several related communities, including Interaction Design, Pediatrics, Sociology, etc. This framework (built in the consideration of pre-adolescent children (i.e., ages 8-13)) is intended to both

inform designers of new children's social networking sites and evaluate existing sites for their appropriateness, while identifying areas for improvement.

3.1 The CSNS Design Framework

The great disparity in design decisions among CSNS designers inspired us to seek scientific evidence to determine the appropriateness of such decisions. Specifically, in this chapter, we present a framework of design principles and best practices supported by scientific evidence regarding ten integral constructs of online social networking sites in the context of CSNS. Though other works present similar sets of principles to inform the design of graphical interfaces for children (e.g., [65, 44]), this chapter presents topics specific to CSNS. The following sections explore scientific work from a wide range of research communities, including child interface design, pediatrics, educational psychology, and many more. Research regarding social networking among pre-adolescent children is scarce, in these cases, we defer to research with teen subjects.

3.1.1 The Ten Constructs

The ten constructs of the CSNS Design Framework are organized into five themes: Identity, Security, Communication Modalities, Community, and Active Participation Strategies. We chose the ten design constructs presented here from among a larger pool of constructs we empirically constructed based on our own experiences as CSNS designers. Many constructs from our original pool (i.e. efficacy of Friending vs. Following, efficacy of wall posts vs. @mentions, etc.) were omitted in this chapter due to lack of definitive

evidence.

3.1.2 Literature Search Procedure

In the writing of this chapter, we performed an extensive literature search. We explicitly searched the ACM Digital Library, the IEEE Xplore Digital Library, PsychNet, and the selection of books at our university library. When, on occasion, these sources were insufficient, we expanded our search to include Google Scholar. We used a plethora of appropriate search terms (e.g., "child online social network avatars," "child digital media profile pictures," etc. for the Profile Picture construct within the Identity theme). When no relevant peer-reviewed literature was found using "children" we expanded our search terms to include "teens."

There is still a relatively limited amount of published work providing insight on social networks for pre-adolescent children. For instance, on first glance, a Google Scholar query for "children's online social networks" (the most general of our search terms) returns about 28,000 results. However, of the first 50 search results, only 9 describe peer-reviewed studies that include pre-adolescent subjects and discuss social networking (though these works are not guaranteed to include pre-adolescent-specific conclusions); 19 search results discuss adolescent or young-adult issues; and 23 search results are either not peer reviewed or are otherwise unrelated. As such, we expanded our search as widely as possible to gain the information desired.

The first theme we address is Identity.

3.1.3 Identity

When online, one may choose to assume the identity of anyone, whether real or fictitious. Though most children present themselves realistically [74] (or at least as a carefully-crafted compilation of all of the child's best attributes [77]), many adopt different personas (e.g. adopting a 'gangsta rap' style of language) while participating in online social media sites. The children recognize that these personas are not a true reflection of themselves, but they see this digital identity as a token to play with and manipulate as they undergo developmental and personality changes [34]. Participating in social media allows children to take the reins of their own personal development, a responsibility children embrace steadfastly [34, 18]. However, because of the lower levels of maturity in children, this freedom to explore identity needs to be carefully balanced with security and privacy concerns. In this section we will discuss two elements of social networks that most exemplify identity: profile pictures and usernames.

Profile Pictures

A profile picture in the context of social networking is the small picture or icon that designers frequently display on a user's profile and alongside their content elsewhere on the site. Some CSNSs (i.e. Club Penguin, Skid-e-Kids) provide complex cartoon avatar creators while others (i.e. Kuddle, KidzWorld) allow users to upload real photographs of themselves as their profile picture. Are photographic profile pictures appropriate for children? Which type of profile picture fosters more community?

Julie Posey, a victim of child sexual abuse turned online crimefighter, asserts that

"Children should never give out identifying information, or send their picture to a stranger. They should not post their photo on their online profile because it may cause them to be targeted [by pedophiles]" [155]. This advice is especially important, Posey says, considering the increasingly sexualized profile pictures uploaded by young people [155] — particularly girls [163]. Despite the advice to restrain from posting photos of themselves online, 91% of teens do post a photo of themselves on their online profiles [153].

Research has shown that photographs and photorealistic representations do not actually improve the quality of online relationships in the long term [211]. In actuality, people tend to share in deeper and more personally-fulfilling conversations when avatar profile pictures appear less photorealistic (maintaining features like hair color, skin color, etc., but still appearing slightly cartoonish) [9]. Even when given the choice to create a photorealistic avatar, most social network users choose non-photorealistic representations that maintain some resemblance of their real appearances [67, 47].

The costume chosen for the cartoon avatar is vital in that it signifies the role that the user is to play in the community (i.e. athlete, hipster, etc.) [201]. We have found in our own experiments with children on our custom social network [206], these roles are treated as venues of identity exploration. One 12-year-old-girl in our study created an avatar for her profile which wore clothing reminiscent of skateboarder or goth style. Her friend commented, "You wouldn't wear that. I've never seen you wear anything like that." The girl responded defensively and a bit defiantly, "I would, too. But my parents won't let me." The tone of her voice ended the discussion. Another girl in our study made requests on

four different occasions to increase the number of outfits allowed for the avatars (requests which were, of course, granted). She reported to enjoy "the clothes" more than any other feature of our social network [206].

Thus, there appears little direct benefit of including photographic or photorealistic profile pictures on CSNSs. Rather, cartoon avatars promote the identity exploration that children crave and the deepened quality of digital relationships that CSNSs designers strive for.

- Non-photorealistic avatars may lead to increased socialization.
- Allow children to create avatars that maintain general features but also encourage identity exploration.
- Avatar creators should include a wide variety of choices, especially for costumes and clothing.

Usernames

There is great disagreement among social network developers as to the appropriate usernames for kids to assume on their profiles. Kuddle and Togetherville, for example, force children to use their legal names when registering in order to prevent the anonymity that fosters fears of cyberbullying. However, most cyberbullying is not anonymous [139]. On the opposite extreme, some social networks, such as Disney's Club Penguin, forbid the use of real names. Real or fictional — which is most appropriate for children?

As children approach their adolescent years, they begin to care deeply about fitting in to the homogeneity of their peer groups. At this age, names begin to imbue more impor-

tance, especially when a child's name strays beyond the norm [25]. Children with common names such as Mary and Tom have been found to be more popular than children with uncommon names [133], and when children choose their own names, they are more likely to choose names that are either popular in their peer group or that reflect popular culture [25].

Though real names inherently reflect the self [74], nicknames have been shown to help develop group cohesion [53]. In practice, a majority of teens (70% by one study [74], 92% by another [153]) divulge their real names on their social networking profiles, even when they don't use their real names as their usernames.

In our own work with social networks for children, [206], we found that children vehemently protested against usernames we created for them. In response, we allowed the next group of children joining our social network to change their usernames if they were displeased with the one assigned to them. Only two of fourteen children chose to change their usernames, indicating that children want the *power* to change their usernames, but do not necessarily feel compelled to actually make the change. Additionally, the two children who did choose to change their usernames were quite inactive on the site, which may suggest (with more data) that username requirements have little effect on CSNS participation.

Design Principles:

- Nicknames can help develop group cohesion.
- Real names are integrally tied to self identity.
- The use of real names does not necessarily discourage cyberbullying, since most cyberbullying is not anonymous.

- Children need to feel as though they have the power to make their own choices about their online identities.

3.1.4 Communication Modalities

The Communication Modalities theme brings into question the specific mediums through which children can communicate with one another on social networks. With the developing level of linguistic sophistication in children, is textual communication an expressive (enough) medium? Does the risk for shared inappropriate content outweigh the benefit of multimedia's social nature?

Textual Communication

Textual communication on CSNSs has two distinct disadvantages. Firstly, children do not yet have the level of proficiency or expressiveness with written language as do adults. This may lead to frustration in communicating what children (specifically younger children) want to say. The second disadvantage is this: given the freedom to say whatever they want, children might choose to divulge private, embarrassing, or hurtful things about themselves or others.

Textual communication is expanding to increasingly younger populations via SMS texting. A recent study indicates that one in ten British children has a mobile phone by age 5, and though it is unknown whether these phones are text-enabled, the average price for a child's first phone (about £125) is enough to buy an entry-level smartphone [2]. The study also found that the average age for a child to receive a mobile phone is 11 years, 8 months. In a study of teenage cell phone use, researchers found that teens spend more

time texting on their phones than talking and 47% of teens claimed they could text while blindfolded [38]. This evidence suggests that most children already use unrestricted textual communication freely.

The advantages of online textual communication from the standpoint of children are twofold. Firstly, the delay between messages allows children time to *edit themselves*. Children can fashion their responses to reflect the online identities they've chosen for themselves (often a smoothed and perfected version of their real identities) [77]. This gives children a chance to be sure what they're about to say is socially acceptable in their peer group. The second advantage is *emotional control*. For example, if a child tends toward emotional outbursts, when she reads a message that upsets her, she has the opportunity to express her frustration off-line, while remaining cool and respectful online [77]. To prevent online emotional outbursts, Dinakar et al. proposes enforcing delays between the writing of a strong or negative response and actually posting it [41].

In our experiments deploying a CSNS to a group of Girl Scouts, we found that plagiarism can cause hurt feelings on CSNSs, specifically when the plagiarized material is an original work (poem, story, etc.) submitted as part of an official site activity. Because these works are the intellectual property of the original author, CSNS designers should consider reporting and/or prevention techniques to deal with this issue.

The informal nature of email and text messages is strikingly different than the personal letter style of the past, but the quirky informal style is no less expressive, even for children [78].

Design Principles:

- Children already actively communicate textually, so restricting free textual communication may result in frustration.
- Consideration should be given to maintaining content ownership, particularly of artistic creations.

Multimedia Sharing

While exploring this theme of communication modalities, we must recollect the fact that a child's online identity is considered almost a tangible expression of his or her self [34]. As such, many youth choose to share on their CSNS profiles information about their musical tastes, television shows and movies that they enjoy, photos of bands or celebrities they like, etc. [77]. Because fitting in to one's peer group is vitally important to pre-adolescent children, media sharing allows children to both conform to the homogeneity of their peer group (by liking items that are popular) as well as contribute to the homogeneity (by sharing items that aren't popular (yet)). Social sharing of multimedia allows for consumption of media and adoption of favorites in non-traditional ways. Children no longer need to rely on television networks to suggest and schedule their favorite shows, rather social media allows friends to make the suggestions [77].

Though the evidence supports that multimedia is certainly important to children and children's identities, is this worth the risk of exposing children to the possibility of viewing inappropriate content? The risk lies in the content itself, as well as the advertisements on the sites where the content originated [144]. Many sites which are frequented by chil-

dren and adolescents are now prohibiting ads as protection for the children, but large media sources such as YouTube[1] do not yet prohibit advertisements [144]. However, with the prevalence of media embedding techniques, children need not actually visit the sites where shared media originated, which minimizes the risk of inappropriate advertisements if multimedia sharing were to be enabled on a CSNS.

Though there is risk of of accidental exposure to inappropriate content, we must consider this issue in the context of children's daily lives. Engaging with multimedia is already an activity prevalent in children's online use [77]. Consider that any new activity added to a child's daily schedule (in this case, participation in a new CSNS) necessarily displaces other activities [137]. Since children already browse multimedia frequently, the activity displacement would be minimized (and hypothetically engagement would increase) if children can browse carefully moderated multimedia within the CSNS.

Design Principles:

- Opinions of multimedia are integral to pre-adolescent identities, so CSNSs should provide some method to display and share favorites.
- Designers should ensure multimedia embeds, rather than navigates to other sites.
- CSNS designers should provide simple moderation affordances for flagging and removing inappropriate multimedia content.

[1] http://www.youtube.com/

3.1.5 Community

We have established in the previous themes that peer groups are very important constructs in pre-adolescent life, both online and offline. In this theme, we explore the options CSNSs provide in both enabling and facilitating peer group interactions. First, we will discuss the role of formalized digital Friendships, and whether their constructions and deletions are appropriate for children. Second, we will discuss Groups and whether the open forums they supply are safe for CSNSs.

Friendships

The definition of a social network requires that users must be able to "articulate a list of other users with whom they share a connection" [19]. We will call these "articulations" Friendships. (In this section, we will use Friendships to denote the online representation, and friendships to denote the emotional construct.) One social network, Kuddle, allows Friendships to be created, but prevents their dissolution as a measure to protect against cyberbullying. Should children have the power to dissolve Friendships? What methods of online Friendship are appropriate for pre-adolescents?

There are two main strategies for formalized digital Friendship. Some online social networks (e.g. Facebook[2]) use the bi-directional Friendship strategy: a Friendship is a bidirectional link between two people, and both people must consent to the Friendship's creation. Alternatively, some social networks (e.g. Twitter[3]) use the Follower strategy:

[2]http://www.facebook.com/
[3]http://www.twitter.com/

Friendship links are uni-directional, meaning user A could Follow user B without user B also Following user A. Though we have found no evidence suggesting one strategy or the other is more beneficial to children, we do know that, like the reporting of inappropriate behavior, the process for adding and removing friends must be very simple [131].

The number of Friendships or Followers a person has is considered a popularity status symbol among adolescents: the more Friends, the better [12]. However nearly all of these Friends are people that adolescents know, at least marginally, offline [77]. Online social networks may be facilitators of existing friendships and incubators of acquaintanceships, but very rarely are new friendships *created* online [77]. The few exceptions to this rule are those children who do not fit into a local peer group, who seek beyond it to gain emotional support or to join a specific interest Group [77].

One adult social network, MySpace[4], experimented with a feature called "Top Friends," which allows users to choose a small number of the user's closest friends to be displayed in a special section of the user's profile page. This forced hierarchy of friendship, the decision to choose between "best" friends and "bestest" friends [77], has been found to lead to frustration and hurt feelings in adolescent peer groups [77].

Rejecting and dissolving Friendships are also sources of frustration and drama among adolescents. Generally, de-Friending only happens in times of conflict, such as after a fight or a breakup [77]. The severing action is thought to be done intentionally and spitefully, which adds to the negative social stigma of de-Friending. This may prevent adolescents from de-Friending acquaintances they hardly know, at the risk of offending them. Despite

[4]http://www.myspace.com/

this, 74% of teens have deleted someone from their online profile [153]. It is considered socially acceptable to de-Friend strangers [77]. Teens frequently do this when changing their privacy strategies to include only those friends that they actually know, or only those who they know well [77]. This indicates that sometimes teens confirm Friendships and later regret that choice.

Design Principles:

- Procedures for establishing Friendships should be simple.
- Providing structural hierarchies of Friendships may be divisive within the community.
- Though dissolving Friendships can be done spitefully, the freedom to remove friends allows freedom to remedy mistakes and control one's own online privacy.

Interest Groups

Many online social networks, even those intended for children (e.g., KidzWorld, Skid-e-Kids) include constructs of Groups. Generally, a *Group* on a social networking site is a page on which a group of people who have formally attained membership can discuss and learn about a specific topic. Topics on CSNSs Groups range from popular music, to sports, and even to news and politics [77]. Some social networks provide *Forums*, which offer the same functionality as Groups, but usually do not require membership. Forums and Groups are key constructs of adult social networks, but are they appropriate and/or necessary for children?

Interest Groups are usually made up of people from many local contexts, and thus

are often made up of people who have not met offline [77]. As mentioned above, communication with those outside of local peers is relatively uncommon on CSNSs, except by those whose interests do not fit in to the homogeneity of their local peer groups [77]. For those children, Groups provide the support that is missing in their physical worlds, to make them feel a sense of belonging and the confidence which follows [77]. The communication on special interest Groups can be deeper and more sophisticated than communication elsewhere on SNS because the focus is on excitement about the topic, rather than socializing [215].

The size of the Group may be a factor in whether a child participates in Group activities. Larger Groups can be seen as intimidating [77], likely because they provide more possibility for ridicule, which is contrary to the desire to be favorably evaluated by those around them [12].

Design Principles:

- Interest Groups are not popular among all users, but are very important for those who struggle to fit into their local peer groups.
- Group membership sizes should be kept small, to encourage participation.

3.1.6 Security

The greatest concern of parents of children on CSNSs is online safety [138]. News stories seem to appear weekly describing a new tragedy resulting from cyberbullying, online sexual predation, or the like. Though these occurrences are relatively rare, many CSNS designers attempt to protect their users from these cyber-threats in various ways. In this

section, we discuss the viability of many of those strategies, as well as strategies of parental supervision.

Parental Supervision

Children require supervision when engaging in potentially dangerous situations. The Internet contains many dangers, and thus parents feel some degree of supervision to be necessary when their children engage in online communities. In the physical world, almost every person the child speaks to is vetted by the parent, or an adult delegated by the parent (i.e. teacher, babysitter, etc.). How do parents vet online companions? Once vetted, how much supervision is necessary?

The stage of pre-adolescence is often accompanied by allowances of time in which children can socialize pseudo-unsupervised in physical environments. That is, perhaps a child can invite a friend into his home and the two can play in a private space still observable by adults on demand, such as the child's bedroom with the door open (the 'open door rule') [103]. In digital environments, parents frequently require teens to participate in online activities in a family space, such as the kitchen, so the child's screen is always visible (the 'kitchen rule') [77].

However, the 'kitchen rule' is not the same level of supervision as the 'open door rule.' With an 'open door,' a parent can walk in and observe the entire environment, including the children involved, conversation topics, activities, emotional expressions of both children, etc. Most importantly, she approved of the visiting friend(s) in the room before socializing began. However, when observing a computer screen in the 'kitchen'

scenario, a parent can merely recognize that her child is engaged in conversation with *someone*, whether approved or not. A more accurate online parallel to the 'open door' is a social network which allows parents to log in at any time to supervise or investigate the entire environment. Additionally, the vetting of CSNS community members is a vitally important process, even if parents entrust this vetting to site administrators the way they do to teachers, babysitters, etc.

Of course, parental supervision can interfere with some social networks built for children in special circumstances. For example, in the design of the social network for children surviving cancer, the children's play therapists, nurses, and parents all agreed that the network should be a parent-free environment to enable a free exchange of struggle and support between the children [214].

From the child's point of view, most children understand that parents place restrictions on internet use (i.e. 'the kitchen rule') in order to protect them [77]. However, by adolescence, children find it extremely important that their parents trust them and their maturing decision-making skills [103]. Anytime parents are explicit about when they trust and when they do not trust their children, the trust of the broad family unit may suffer [56]. To remedy this, everyday supervision of children's online activities should be routine and not only in times when a threat has been detected.

Design Principles:

- Parents or designated parties need to be able to 'walk in and observe' social networks for children.

- Parents need to either vet online connections for their children on CSNSs themselves or trust the parties and procedures that perform that function.
- Supervision on CSNSs should be frequent and routine.

Cyberthreat Prevention

Many CSNSs feature restrictions in order to protect against cyberthreats. Kuddle, for instance, prevents users from commenting on other's posts to prevent cyberbullying and inappropriate communication. Other concessions made by CSNS designers include: preventing the dissolution of friendships; disallowing 'wall posts', and/or status updates; restricting conversation to pre-approved texts and emoticons; etc. Many of these practices inherently prevent the social individuality and the free-flow of ideas (for better or for worse) that so epitomize adult social networks today. Are restrictions such as these the solutions to protecting the security of children online?

Several researchers have proposed tools to prevent cyberthreats against children. Mazari [131] proposes several layers of protection: spam blockers, parental controls, IP-address-tracking, and working with social media designers to make it easier to report incidents of cyberbullying [131]. Rybnicek et al. [173], proposes a Watchdog system to identify sexting, cyberbullying, and predatory grooming through a system made up of image/video analysis, social media analytics, and text analysis. Dinakar et al. [41] proposed a system that enforces waiting periods before posting when it detects ill sentiment in a communication. This proposed system also combines many cyberbullying posts into themes and alerts moderators of the trending issues. Thus, most research focuses on educating

kids about proper netiquette and identifying/reporting inappropriate behavior, rather than the prevailing commercial approach of restricting interaction.

A few commercial CSNSs, namely KidzWorld, rely on child-moderators, users who have shown good behavior and are given the power and responsibility to enforce the site's community standards. Though this is effective in many adult sites (such as StackOverflow[5]), the varying and often limited schedules of children make it difficult to have a moderator in every chat room and forum of Kidzworld at any given moment, so inappropriate content abounds. In our own analysis of about 70,000 lines of KidzWorld chatroom data (provided by KidzWorld under appropriate IRB protocols), we found that about 1 in 30 messages in KidzWorld chatrooms are inappropriate for children (cyberbullying, sexual in nature, etc.).

Many CSNSs (i.e., Eaglespace, Togetherville) take advantage of the legal requirements of parental consent and expect parents and/or teachers to moderate the site. Winn found teacher-moderation very effective for teaching netiquette on Eaglespace [217]. As enrollement and participation increases, however, moderation needs to be simple and efficient, possibly utilizing the "Overview first, zoom and filter, details on demand" design structure [182].

Design Principles:

- Moderation, social media analytics, and other emerging technologies can be leveraged to protect children without restricting their interactions, autonomy, or expressiveness.

[5]http://www.stackoverflow.com/

- Moderation affordances should be simple and thorough, providing a general overview, as well as details when necessary.

3.1.7 Active Participation Strategies

Online communities often struggle with under-contribution, particularly in the early stages when little content exists [118]. Therefore, designers of CSNSs need to understand children's motivations to participate and promote activities that harness those motivations. In this section, we discuss badges (awards given to a SNS user for completing a specified activity) as well as other, more general strategies of procuring continued participation.

Badges

Many online social services have adopted the concept of badges to reward and retain users. For example, Wikipedia[6] Barnstars enables users to reward one another for producing good work, StackOverflow rewards users for active and productive participation, and FourSquare[7] rewards users for sharing their locations via check-ins [5]. Badges help to make the social context within online communities more visible, by providing tangible evidence of a user's status [63]. However, in the context of CSNSs, are badges an appropriate and sufficient technique for securing continued engagement?

Badges bring manifold benefits to a social network. Firstly, badges can provide structured goal-setting, which sets rewards just outside of a user's reach. These incremental challenges (for both individuals and groups) have been shown to be the most motivating [118]. Secondly, badges can instruct new users about appropriate behaviors and valued ac-

[6]http://www.wikipedia.org/
[7]http://www.foursquare.com/

tivities within the community. This benefit can be attained even if the users do not actually complete the activities required to earn the badge [5]. Thirdly, the quantity and quality of badges earned can contribute to a user's online reputation. Users are motivated to complete badge-earning activities because they feel others will look upon them more favorably by doing so [14]. Finally, badges promote a sense of similarity between the user and the other members of the community [5], which is very important for pre-adolescent children. Even with all their benefits, researchers warn that badges do not inherently inspire social engagement, and should not be the sole factor to encourage participation [5].

Researchers have shown that using rewards to motivate children can undermine a child's intrinsic motivation (the desire to do something because one wants to, rather than because they will earn a reward for it), especially if the child feels they are being controlled by the person offering the rewards [40]. Therefore, a child user of a CSNS should not feel obligated to complete badge activities, rather they should feel autonomous. Autonomy provided within digital activities for children has been shown to increase intrinsic motivation [172].

Design Principles:

- Badges should help children to understand the behaviors expected of them as members of the digital community.
- Badges should not be used as an attempt to gain participation, rather they should be used to teach and reward appropriate participation.

Retention Strategies

As mentioned in the previous subsection, extrinsic motivators like badges cannot be the sole motivators in a digital system for children. *Intrinsic* motivation is also necessary. One way to bolster intrinsic motivation is by providing children with a myriad of choices to customize their environments. Names, physical appearances, decorations, and other customizations provide children with the feeling of autonomy [126], which has been shown to increase intrinsic motivation [172].

Additional motivators for participation on CSNSs are social. Social motivators among pre-adolescents focus around a need for approval (NFA) from those in their local peer groups [171]. NFA comes in two forms: approach NFA (the desire to engage in activities in order to elicit positive judgements from peers) and avoidance NFA (the desire to avoid negative judgements from peers) [171].

Approach NFA may be especially motivating toward active social behavior, because helping others helps to increase positive appraisals and peer acceptance [169]. However, children who exhibit high avoidance NFA may participate in fewer social interactions because they fear being rebuked and the consequent negative appraisals from peers [169]. These children may thus withdraw from challenging social situations [80], which makes them appear as less-desirable interaction partners by peers [168]. Therefore, to encourage participation by all children on CSNSs, structures should be put in place to encourage positive responses and to discourage negative appraisals.

Naturally, NFA is much lower outside of a child's local peer group. As mentioned the

Community theme above, CSNSs aid existing friendships but rarely foster new ones [77]. Therefore, the communities within CSNSs should include existing circles of friends, rather than collections of strangers or acquaintances. This is an especially important retention strategy for specialized, closed, or invite-only networks.

CSNSs are different from many other digital systems for children in that they require the active participation of parents as well as children. Researchers have found that longitudinal study participants appreciate emails with updates on study progress with non-generic subject lines [55]. Additionally, families who feel personally bonded with the provider are more likely to continue engaging in the activaity [199]. Therefore, if possible, CSNS teams should personally reach out to parents and discuss andy concerns about the network, their motivations to join, etc.

Design Principles:

- Customizations for children's digital environments lead to increased intrinsic motivation.
- CSNSs should provide easy affordances for communicating social approval, but not rejection.
- CSNS communities should strive to accommodate existing networks of friends, rather than random samplings, acquaintances, or strangers.
- Make a personal bond with parents and send updates/reminders about participation.

3.2 Open Questions

Though in this chapter, we have addressed 10 important design decisions for CSNS interface and interaction design, there are many more decisions which we omitted due to a lack of definitive published works. For example, which friendship strategy (Friends vs. Followers) is more effective for children? How effective are child moderators of CSNSs at flagging and removing inappropriate content? What level of censorship (if any) maximises the level of free speech while minimizing inappropriate content? One very basic question we have yet to answer is whether children should be able to write public messages on other children's profiles? What are the identity and security implications of such a choice? Each of these are open research questions which we hope will inspire future research in the area of CSNSs.

3.3 Conclusions & Contributions

In this chapter, we presented an extensive literature review of works related to children, social networking, safety, and participation. From this literature, we compiled a collection of design principles in five themes and ten categories to aid CSNS designers make the integral choices related to affordance selection and site design. This collection of design principles served as a handbook for the creation of our own social networking site, KidGab (explained more in the following chapter), and has the potential to direct and advise the creation of many other social communities for children.

4 KIDGAB[1]

We developed KidGab to bring together existing networks of children such as scouting troops, classrooms and sport teams. By remaining closed to the general public, children can stay safe from ill-intentioned Internet users. An example profile page on KidGab can be seen in Figure 4.1.

The following sections of this chapter detail KidGab's most defining affordances. With each affordance, we offer simple usage statistics from 458 days of KidGab's deployment. (Deeper analyses of usage statistics follow in the subsequent chapters.) Though we present the data incrementally, a complete graphical representation our comprehensive statistics can be found in Figure 4.2.

4.1 Sketching

Distinct from traditional social networks, KidGab is sketch-based. KidGab allows children to send sketches to one another either in lieu of or in addition to textual communications. A screenshot of the sketching interface can be seen in Figure 4.3. Sketches are not stored as static images; they are stored as videos for action-by-action playback of sketch construction. That is, the recipient can view each stroke being added, undo/redo actions, the background color changing, etc. This sketching facilitates simple animations, multi-

[1]Portions of this chapter reprinted with permission from the chapter "The Digital Sash: A Sketch-based Badge System in a Social Network for Children," by Stephanie Valentine, Angelica Leyva-McMurtry, Katya Borgos-Rodriguez, and Tracy Hammond, in *Revolutionizing Education with Digital Ink*, Springer International Publishing, Cham, Switzerland, Copyright 2016 Springer.

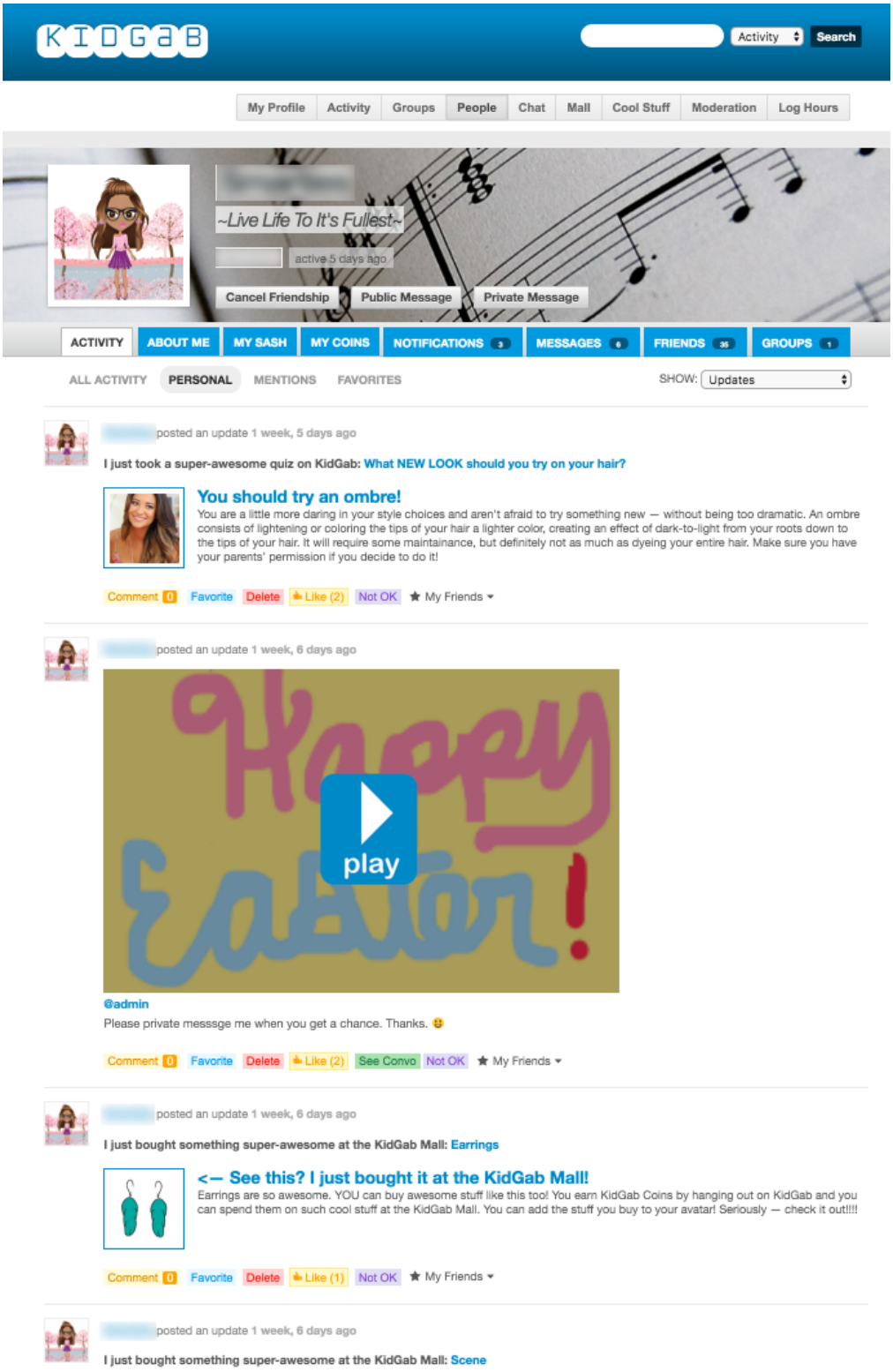


Figure 4.1: A profile page on KidGab.

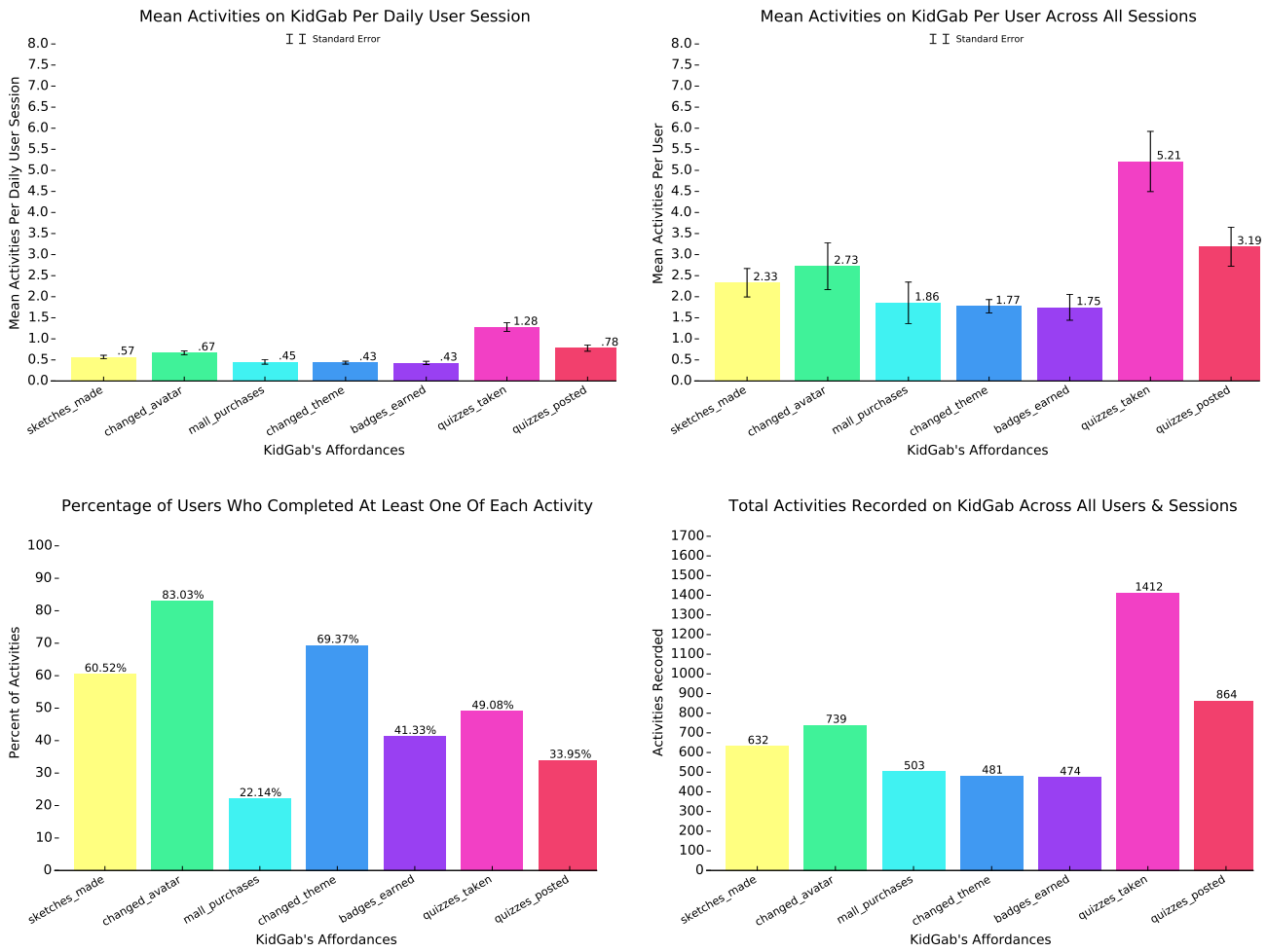


Figure 4.2: Recorded usage of each presented activity on KidGab.

Figure 4.3: KidGab's sketching interface. Users can select between 24 pen and background colors, and four pen sizes.

scene sketches, etc., which is a richer temporal experience than static sketches alone. The sketch videos can be a useful curricular tool, as they can capture step-by-step procedures quite well (e.g., how to solve math problems, growth cycles, multi-scene creative writing).

Presently, our sketching interface provides 24 background colors, 24 stroke colors, and 4 stroke widths. In early versions of our sketch interface, users could select any color in the RGB spectrum and any stroke weight between 1 and 50 pixels. This led to much frustration amongst users. In our early usability studies (not elsewhere discussed in this paper), users struggled to match colors and stroke widths to ones previously employed, which frequently resulted in abandoned sketches. For example, consider the sketch in Figure 4.4 of Despicable Me Minions by an undergraduate student. The student could not

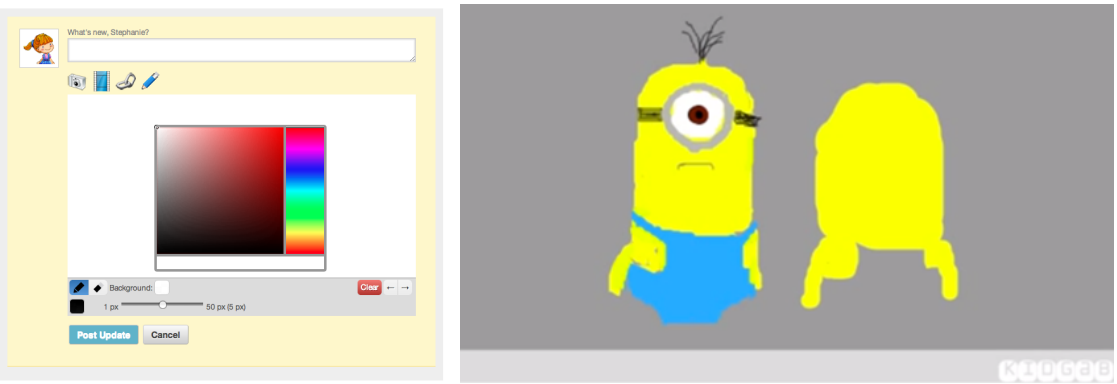


Figure 4.4: Color-matching frustration due to an overabundance of choices by the original sketch interface (left) caused this user to abandon his sketch of Minions (right).

match the exact tint of yellow he previously used for the Minions' skin, so he abandoned his original sketch and began anew.We could have implemented a color-matching tool, often called an "eyedropper tool," but our dedication to creating child-friendly affordances led us to consider a color-selection metaphor familiar to children — a crayon box. Though this limits the selection of colors to 24, we have never received a complaint that the color selections are too few. Our revised and improved interface design is shown in Figure 4.3.

4.1.1 Use Throughout KidGab's Deployment

Throughout the first 458 days of KidGab's deployment, users have created 632 total sketches. A user creates a mere 0.57 sketches per daily user session and 2.33 sketches across all days she is active on KidGab. About 60.52% of users have created at least one sketch. The average sketch contains 45.16 strokes, 2.10 erasure strokes, and 2.28 background color changes.

4.2 Avatars

KidGab provides an extensive collection of cartoon-like avatar-creation components that allows users to express and explore their identities. The avatars also serve another purpose in that they provide children a fun alternative to uploading photographs of themselves to their profiles. Permitting photographic avatars is a practice that is considered dangerous for children under 13 years for multiple reasons: because it may cause them to be targeted by pedophiles [155], because it may cause them to be victims of identity theft (particularly for acquiring passports) [196], and because of the rampant sexualization displayed by young girls in photographic profile images [163].

Our profile creator (Figure 4.5) currently provides (by default) 3 skin colors, 5 eye colors, 2 eye styles, 15 hair styles, 6 hair colors, 50 clothing choices, 6 pairs of glasses, 24 mustaches, 5 hats, 4 bows, and a scarf.

4.2.1 Use Throughout KidGab's Deployment

The 271 users we have engaged in 458 days of deployment have created a total of 739 avatars. An average user changes her avatar 0.67 times per daily session and 2.73 across her entire experience on KidGab. Almost all users have created at least one avatar (83.03% of users). Our longest-active user (who has been active since the first day of KidGab's deployment) has created 143 avatars, each displayed in Figure 4.6. The ever-changing development of avatar components is easily visible in the choices she made for her avatar.

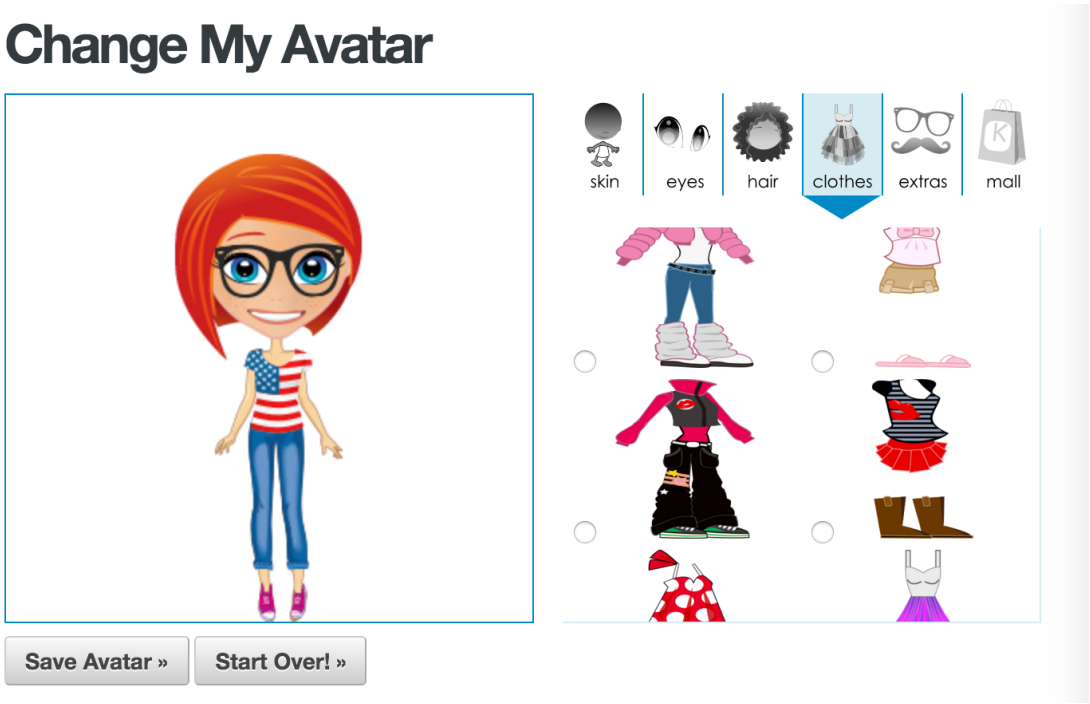


Figure 4.5: KidGab's avatar creator.

4.3 KidGab Coins & KidGab Mall

Inspired by the eagerness with which our users embraced the avatars, and in response to their frequent requests for more and more avatar components, we created KidGab Coins and the KidGab Mall. Coins are the site currency, earned from participating in basic site activities such as making comments, liking posts, earning badges, and taking quizzes. A user can keep track of the Coins she has earned on the "Coins" tab of her profile page (Figure 4.7).

The Mall includes over 500 avatar-customization items (like those seen in Figure 4.8) that can be purchased with KidGab Coins. The Mall currently has 9 stores: Bags & Purses Shop, Jewelry Shop, Accessories Shop, Sporting Goods, Hair Salon, EYEstore, Pet Shop,

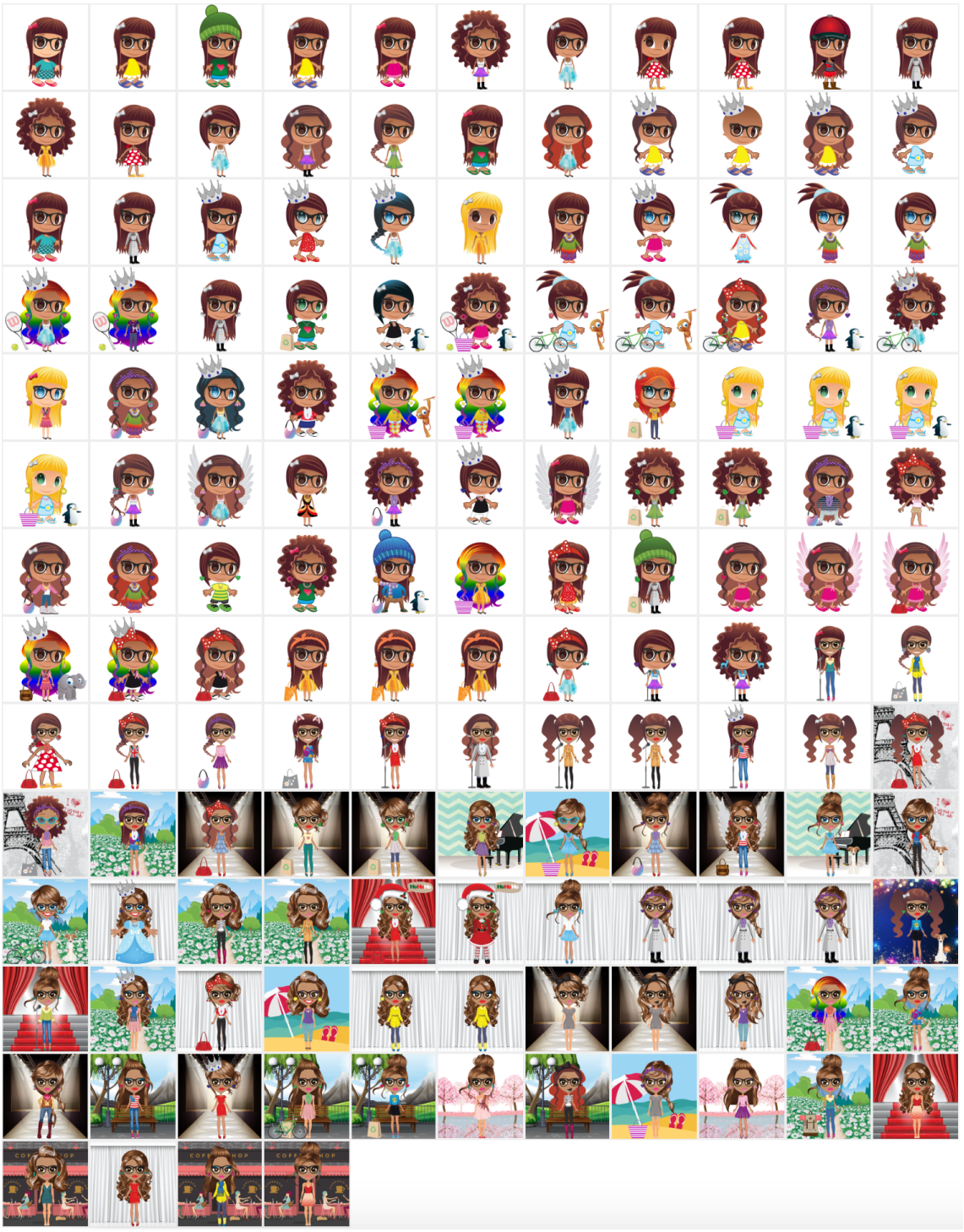


Figure 4.6: One user's avatars across 458 days of deployment. The evolution of the avatar creator is evident in the user's selected options.

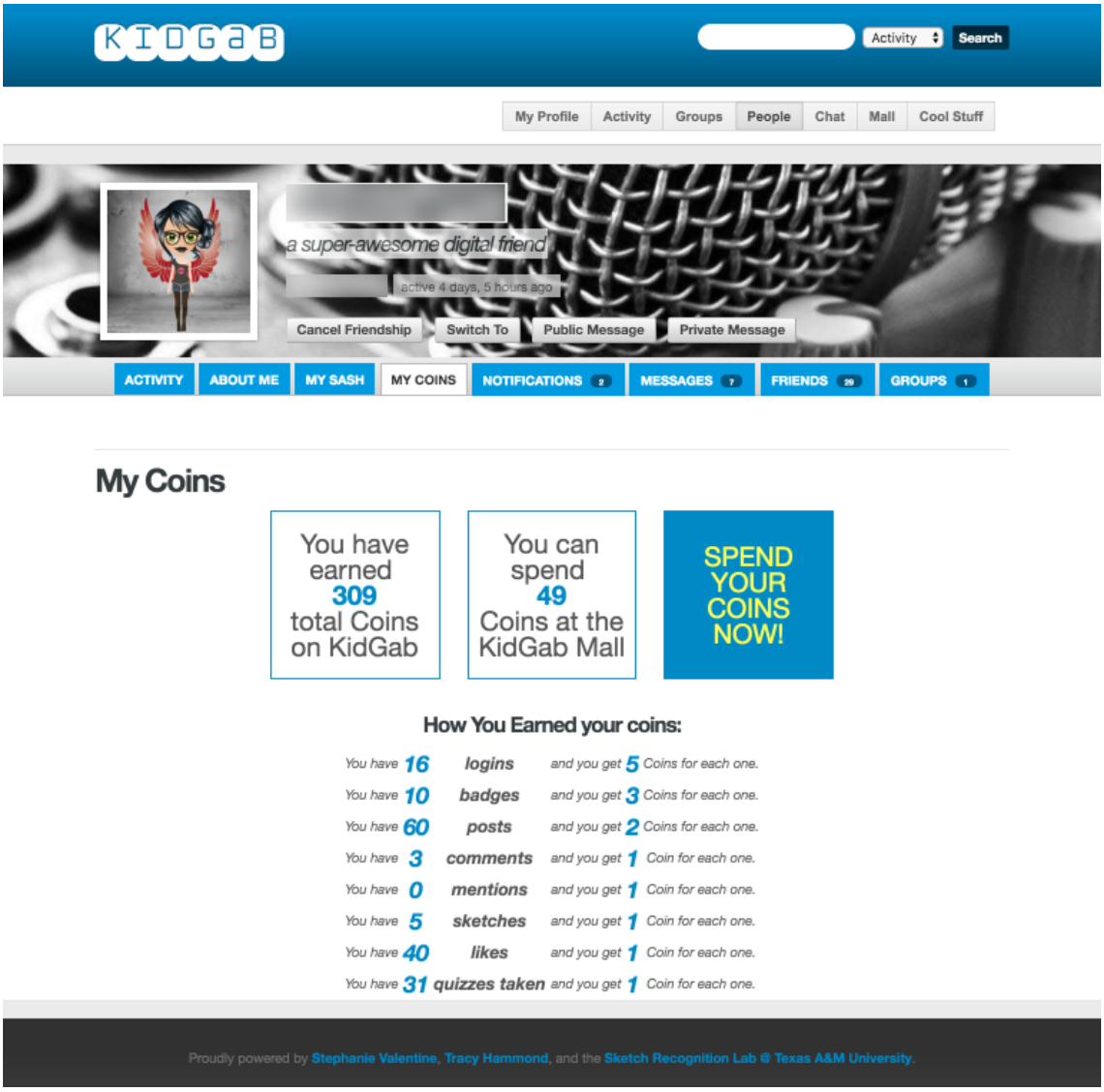


Figure 4.7: The My Coins tab of a user's profile. Usernames blurred for anonymity.

Figure 4.8: Avatars made with components purchased from the KidGab Mall.

Dentist, Clothes Shop, Costume Shop, and Scene Shop. A screenshot from the Pet Shop can be seen in Figure 4.9. The currency system and Mall are also tools to help children understand digital commerce, one of Ribble's 9 principles of digital citizenship [159].

4.3.1 Use Throughout KidGab's Deployment

Throughout KidGab's deployment, our users have earned a total of 35,937 Coins. Of those Coins, our users have spent 12,938 Coins on 503 mall items. The eight most popular items can be seen in Figure 4.10. The sixth most popular item, the "I [heart] Paris" scene, gained most of its popularity immediately following the November 2015 terrorist attacks in Paris, France.

Across KidGab's complete deployment, users earn an average of 32.49 Coins per daily user session and an average of 132.61 Coins across all her daily sessions on KidGab.

Figure 4.9: Jewelry Store at the KidGab Mall.

Figure 4.10: The eight most popular items purchased by users at the KidGab Mall.

KidGab users likewise make an average of 0.45 Mall purchases per daily session and 1.86 Mall purchases overall on KidGab. Of all 271 users on KidGab, 22.14% have made at least one Mall purchase.

However, the KidGab Mall was released on day 174 of the deployment. Of the 147 users whom have logged in since the Mall's grand opening, 40.82% have made one or more purchases. The average number of purchases made per girl since the time of the Mall's grand opening is 3.42 (0.75 purchases per day).

4.4 ThemePark

Because we know customization of one's environment is very important for feelings of autonomy among pre-adolescent children [172], we allow users to choose a "theme" for their profiles using the Themepark feature. Themepark themes appear behind one's avatar in the same way as Facebook Cover Photos. In Figure 4.1, the user chose an image of sheet music from the Hobbies category. In Figure 4.7, the user chose an image of a microphone

(also from the Hobbies category). There are currently more than 30 themes to choose from. Figure 4.11 shows five profile headers decorated with ThemePark themes.

4.4.1 Use Throughout KidGab's Deployment

On each of the 1,106 daily user sessions, an average user changed her theme 0.43 times. Over all of her daily user sessions, she changed her theme only 1.77 times. Despite the ThemePark being available since the first day of the deployment, only 69.37% of users have changed their theme at least once, making it the second least popular activity on KidGab next to earning Badges.

4.5 Badge System: The Digital Sash

Many digital applications (most notably video games) contain a rewards system, whereupon completing specific tasks the user earns a small reward. Having a reward system encourages users to continue engaging with the application in order to earn more awards or achievements. Girl Scouts and other scouting organizations have a similar, albeit physical, system where members have a vest or a sash and can earn fabric patches by completing specific fun activities. Patch activities are usually intended to teach a valuable skill such as money management, woodworking, or expressive writing. In order to simulate a similar environment for our Girl Scout users, we created KidGab's Digital Sash, where the girls can earn digital badges by completing creative drawing tasks and sharing opinions. The badge-earning activities present users the opportunity to practice posting introspective, creative, and appropriate messages, so they retain habits of healthy digital

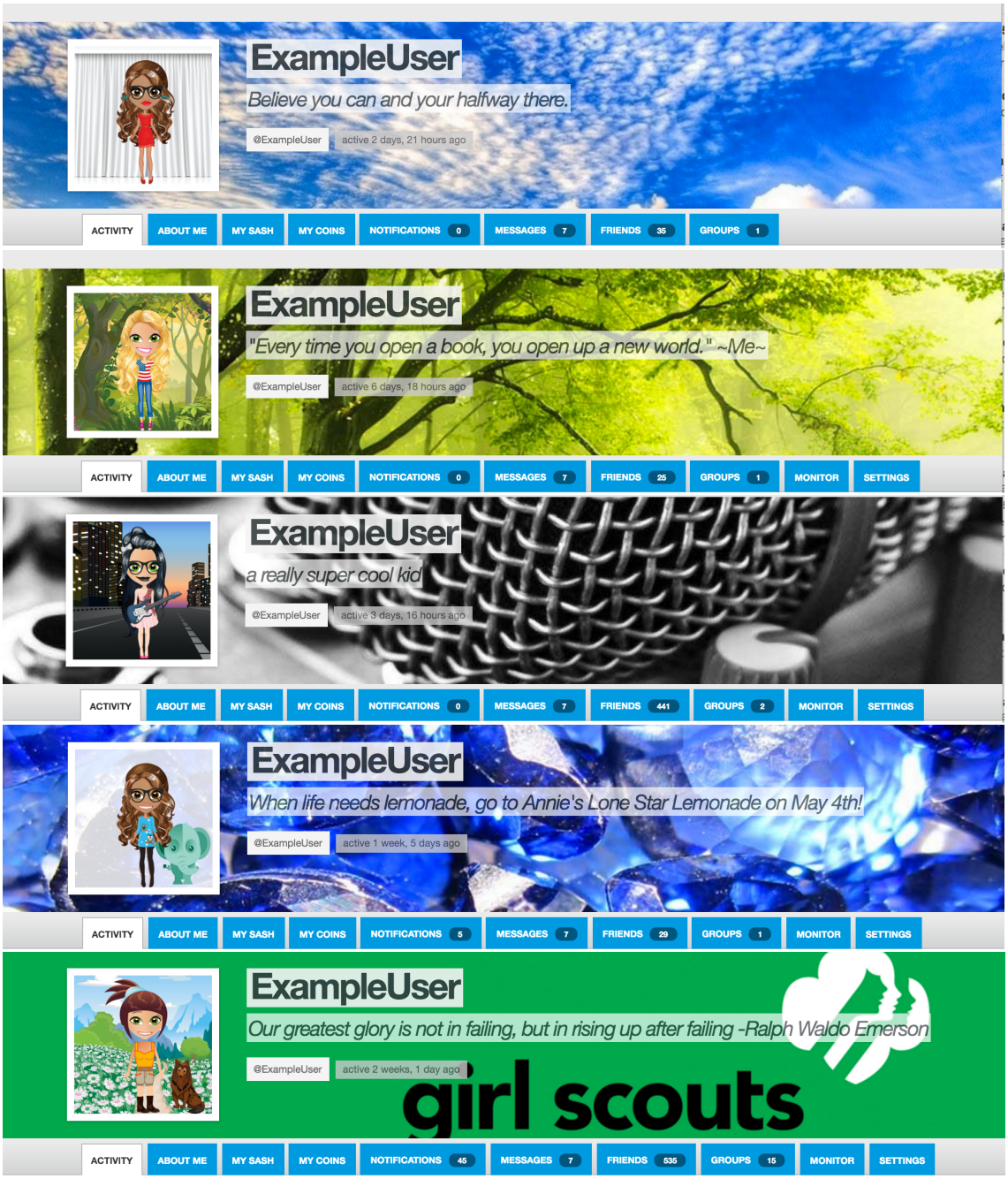
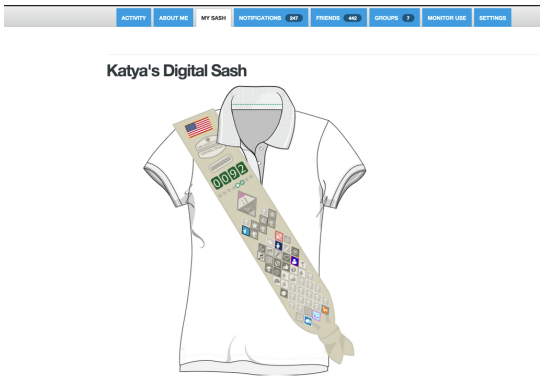


Figure 4.11: ThemePark selections.

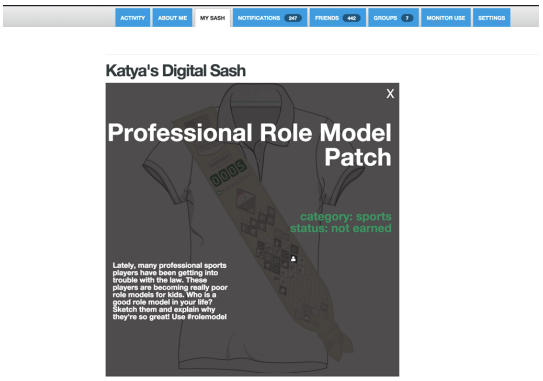
expression and netiquette skills.

4.5.1 User Perspective: Earning a Badge

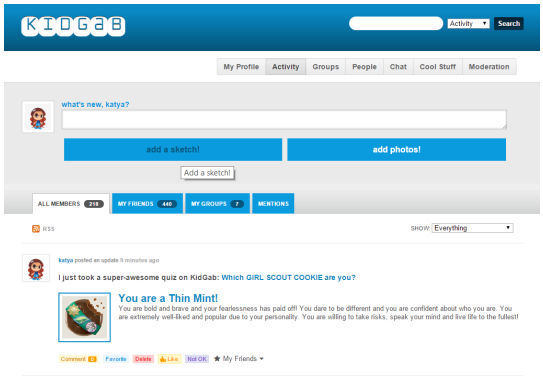
Earning badges in KidGab is quite easy. Consider this scenario: A girl logs in to KidGab and (after checking out her friends' recent posts) navigates to the page that displays her Digital Sash (Figure 4.12(a)). She scans her sash and sees a new grayscale badge she hasn't seen before. The girl knows that the badges she's already earned appear in color and the grayscale badges are yet-to-be-completed, so she knows this badge is something new she can earn. She clicks on the badge (Figure 4.12(b)) and reads the description: "Lately, many professional sports players have been getting into trouble with the law. These players are becoming really poor role models for kids. Who is a good role model in your life? Sketch them and explain why they're so great! Use #rolemodel." The girl decides she wants to earn this patch. She navigates to her activity feed and begins a new sketch (Figure 4.12(c)). She sketches an image of herself and her mother, with their arms around each others' shoulders, showing the love and bond between them (Figure 4.12(d)). After finishing her sketch, she types "I think that mothers are great role models #rolemodel" making sure to include #rolemodel, because that is part of the requirement for earning the badge (Figure 4.12(e)). The girl posts her sketch and instantly sees a comment below her post, saying she earned the Professional Role Model Patch (Figure 4.12(f)). Finally, she clicks the link in the comment, which navigates back to her Digital Sash where she can see that the Professional Role Model patch is now in color!



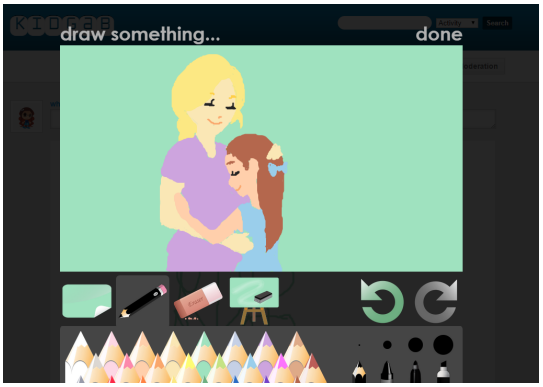
(a) the Digital Sash



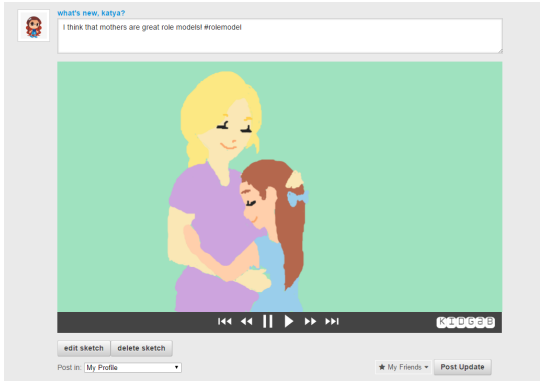
(b) viewing a badge



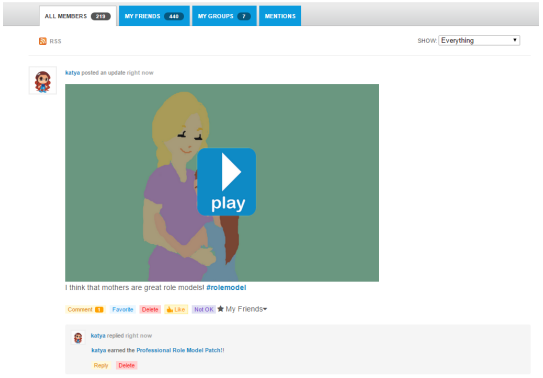
(c) starting a sketch



(d) finishing the sketch



(e) adding some text



(f) posting and earning

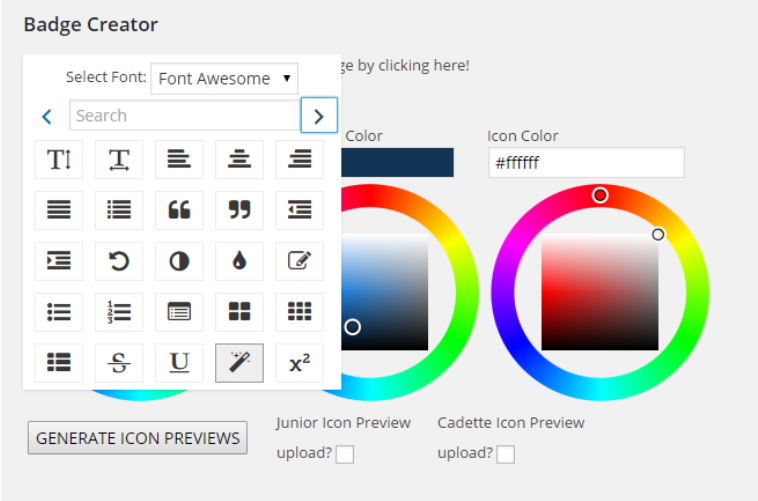
Figure 4.12: A step-by-step illustration of the badge-earning process. This particular example earns the Professional Role Model Badge. Other badges require similar steps but regard different themes.

4.5.2 Administrator Perspective: Badge Creation

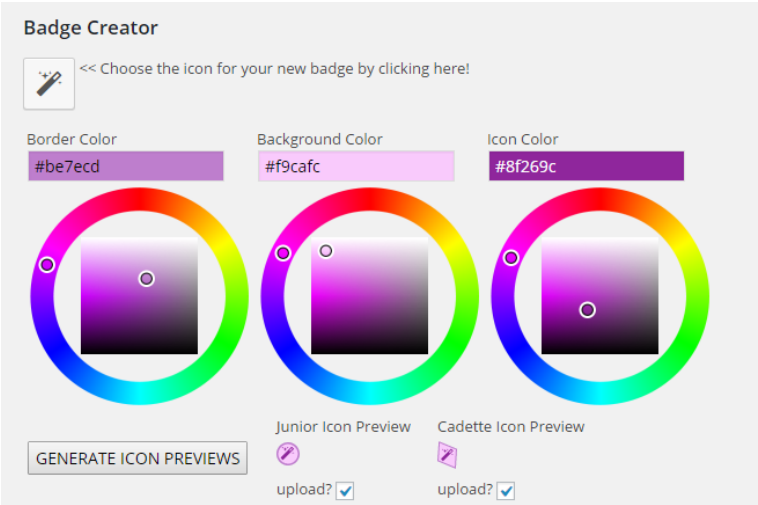
Creating badges on KidGab is as easy as earning them. An admin can create a new badge in the Badges Manager section of KidGab's administrator menu. When defining a new badge, the admin must provide the new badge's name, the hashtag required to earn it, and a description of the earning requirements so that users can understand what they must do to earn the badge. The final step in creating a badge is to select the artwork that will serve as the face of the badge. The admin can choose whether to upload a badge image she manually created or whether to use KidGab's custom-built badge-creator tool. The badge creator tool allows the administrator to choose between a variety of vector icons to become the decorative and descriptive centerpiece of the badge (Figure 4.13(a)). After choosing an icon, the administrator can choose the border color, background color, and the icon color of the badge. With a click of a button, KidGab generates SVG images using the icon and colors selected (Figure 4.13(b)), thus providing great time savings compared with designing, creating, saving, and uploading the images manually. The admin can tweak the design of the badge until satisfied, and then "Save Badge" when the artwork and descriptions are complete.

4.5.3 Administrator Perspective: Badge Curricula

For each cohort of children joining KidGab (all children who have joined KidGab have done so through one of the Digital Friendship Workshops), we design a custom curriculum of badges to suit their unique interests, upcoming holidays, etc. On average, we release about one badge per cohort per day. In the days immediately following the work-



(a) choose an icon



(b) generate previews

Figure 4.13: KidGab can automatically generate the artwork for Badges based on an administrator's choice of icon and colors. Generated badges are small and appear in the lower portion of (b).

shop, we release more than one badge per day, and we progressively slow the release rate to about one every other day. Badge curricula usually span about 6 weeks. Badge releases are automatically announced by KidGab in the form of status updates by the "KidGab Admin." A released badge will also appear in grayscale on a girl's sash, indicating that it is ready to be earned.

Randomness and variety within the badge curriculum is important. We found that focusing on one theme (e.g., March Madness or Weather Patterns) generally reduced interest in the earning of badges. Now, we try to alternate between serious, silly, fashion-related, sporty, and creative badges in order to reach girls with a wide range of interests. Varying the requirements for earning badges is also important, so in the curricula we attempt to strike a balance between text-based and sketch-based badges.

4.5.4 Generalizability

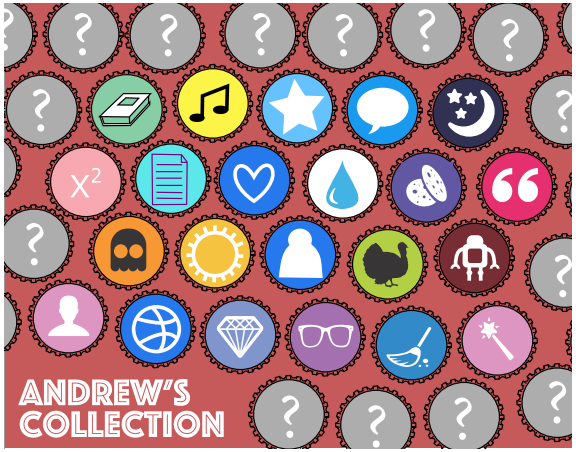
Our Digital Sash has faced criticism for being too specific to the Girl Scouts domain and too difficult to generalize to other populations. We see great potential for the results to generalize to a wide range of domains, and we illustrate a few alternative badge system metaphors below.

Our first metaphor is the marble jar. A marble jar metaphor (a mock-up example of which can be seen in Figure 4.14(a)) would be ideal for a school or classroom environment. This is a digital representation of a physical reward system used in elementary classrooms. When a class behaves exceptionally well or accomplishes preset goals, the teacher adds marbles to a clear glass jar. If the class behaves poorly, the teacher removes marbles from

(a) Marble Jar

(b) Trophy Shelf

(c) Charm Bracelet



(d) Bottle Caps

Figure 4.14: Alternative artwork for generalizing the Digital Sash.

the jar. When the jar fills, the class earns a treat, like a special holiday party or extra recess. This metaphor can easily extend to a digital badge system. As a user completes the digital activities and the marble jar fills, he can see his progress toward earning some other great reward (as determined by the teacher, coach, etc.). Advantages of the Marble Jar are the perceptually quantifiable progress level and the ease of comprehending which activities have been completed (those inside the jar) and which have not (those outside the jar).

Another approach might take the form of a trophy shelf (a mock-up example of which can be seen in Figure 4.14(b)). In the same way that participants are rewarded trophies for excelling in sports competitions, children could be awarded trophies for completing activities and being active on the site. As in competitions, trophies would be given a rank according to how difficult they are to obtain. These ranks could be bronze, silver and gold. Once obtained, the trophies would be placed on the respective shelf within the user's trophy wall, as seen in Figure 4.14(b). This Trophy Shelf approach to a badge system is gender-neutral; both boys and girls are likely to enjoy collecting trophies and the satisfaction of owning a significant amount of them.

A slightly more gender-specific badge metaphor is the concept of charm bracelets (a mock-up example of which can be seen in Figure 4.14(c)) . Many young girls enjoy collecting charms that identify items or activities they love. Each completed activity would provide a new charm for her digital bracelet. While this approach is specific to an audience of girls, it would be a fun and age-appropriate rewards system for girls within the target age-group (7-12 years).

Collecting bottle caps is a hobby that has been practiced for many years. More than a hobby, it has become an art. Inspired by bottle cap walls, we propose a system (an example of which can be seen in Figure 4.14(d)) that will award KidGab users bottle caps for their participation in the website and allow them to have personal bottle cap walls. Once obtained, the bottle caps may be arranged within the wall to their liking, thus allowing users to be creative with their spaces. This itself allows for another appealing activity; being able to share bottle cap walls and observing other users' creations. Such customizations have been shown to improve intrinsic motivation and participation rates for children's software applications [126, 172].

4.5.5 Use Throughout KidGab's Deployment

At the time of writing, 271 Girl Scouts have joined KidGab. The Girl Scouts have created a total of 3,159 posts. The girls have earned a total of 474 badges (0.43 badges per daily session, 1.75 across all sessions).

The most popular post-to-earn badges are American Girl (with 114 earners) (we include the earning of this badge in the workshops), Texas Girl (with 28 earners), Dream Diary (with 26 earners), A Sister to Every Girl Scout (with 25 earners), and Fun Fashion (with 22 earners). The Sister to Every Girl Scout badge does not require sketches, but often girls chose to add sketches anyway. We provide descriptions and a selection of girl responses for all five of these badges in Figure 4.1.

One badge that was not among the most popular (only earned by 16 users), but surprised us in terms of the thoughtfulness of the responses is the Water Is Important badge.

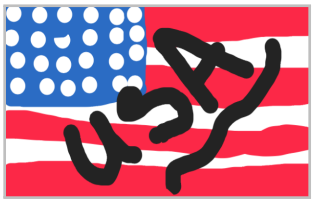
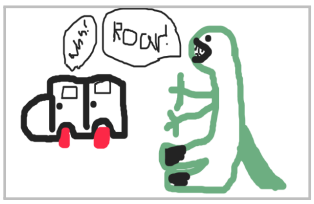
Badge Name & Description	Example Girl Response	Example Girl Response
American Girl Earn the American Girl Patch by posting a sketch of an object you think is uniquely American. Use hashtag #americangirl!	 #americangirl	 #americangirl
Texas Girl Earn the Texas Girl Patch by posting a sketch that reflects how you feel about living in Texas. Use the hashtag #texasgirl!	 #texasgirl	 #Texasgirl How I feel about Texas:
Dream Diary Earn the Dream Diary Patch by sharing a dream you have had with your friends on KidGab! Sketch out what happened and be sure to tell the story in words too! Use hashtag #dreamer!	 I had this dream of me and my family when I was like in the third grade #dreamer	 By far the best dream I had was CANDY LAND! It was so cool. Everything was made up of your favorite type of candy you name it had it. #dreamer
A Sister to Every Girl Scout KidGab was built in order to provide Girl Scouts a place to talk, joke, laugh, and make friendships stronger online. How do you think you can use KidGab to be a sister to every Girl Scout? Use #sister to share your idea and earn the Sister to Every Girl Scout patch!	#sister Kid gab helps me be a sister to everybody because it gives me the chance to meet new people and have a great time with them online! It's great to know that I have my fellow sisters that are there for me!	 #sister
Fun Fashion I find that I wear the same jewelry every single day! I think it is time to mix it up! What is your favorite fashion accessory? Fun glasses? Bright shoes? If you do not have a favorite, design one! Sketch it out and use the hashtag #funfashion to earn the Fun Fashion Patch!!!!	 #funfashion a super cute fave color necklace :-)	 i like wearing long socks #funfashion

Table 4.1: Descriptions and example responses (drawn by KidGab Girl Scouts) for the five most popular badges.

This badge is one of the "serious" badges and encourages the girls to think with a global perspective. Instructions for earning this badge are: "Did you know that there are people around the world that don't have access to fresh water everyday? Write how you feel about that, use #waterisimportant." One girl wrote:

> I hate how some places don't have access to water. I [learned in] my geography class this year that most 3rd-world countries aren't able to have water because the "government" there won't let go to the poorer cities: It's like they play favorites and they give the water to the better cities rather than the poorer ones. I hate it. #waterisimportant

Another girl wrote:

> I think everybody should appreciate the water they have cause some people don't have any water so we should all preserve water so we can have have water hopefully someday everbody in the world will have water #waterisimportant

Seven girls have earned the "Water Is Important" badge, which is significant, since it is usually released in weeks three or four of the badge curricula (earlier-released badges usually receive many more responses). We think this reveals that children are capable and willing to communicate serious and even political opinions on KidGab, providing them with valuable experience in practicing digital citizenship skills.

4.6 Personality Quizzes

Personality quizzes are fun, non-scientific surveys that ask multiple-choice-style questions related to a user's preferences and personality. The user selects the answers she believes to fit her best, and after submitting her selections, she receives a singular result summarizing her personality in the context of the quiz's theme. Examples of such questions can be seen in Figure 4.15(a), and a sample result is shown in Figure 4.15(b).

For example, the "Which instrument would you play if you were in a band?" quiz has the results "Guitarist," "Bassist," "Drummer," and "Lead Singer." To promote the sociality of personality quizzes, KidGab provides girls the ability to share their results with their friends. If a user chooses this option, KidGab automatically generates a post for her that incorporates the quiz title, result description, and an entreaty for her friends to also take the quiz (Figure 4.15(c)). We try to release at least one new quiz per week.

4.6.1 Administrator Perspective: Writing a Quiz

The initial process for writing a personality quiz was time consuming and complex. The quiz author would first choose about four result classes (these are the results you could receive after taking the quiz). Each result class needs a description, which the quiz author might compose either on paper or in a text editor. Next, the quiz author would write a series of at least 7 questions with one answer per result class (again, the author might record these on paper or in a text editor). After completing the quiz composition, the author would create a new KidGab page and an HTML form with radio-button groups for each question. The author would need to compose several JavaScript functions to score the quizzes and

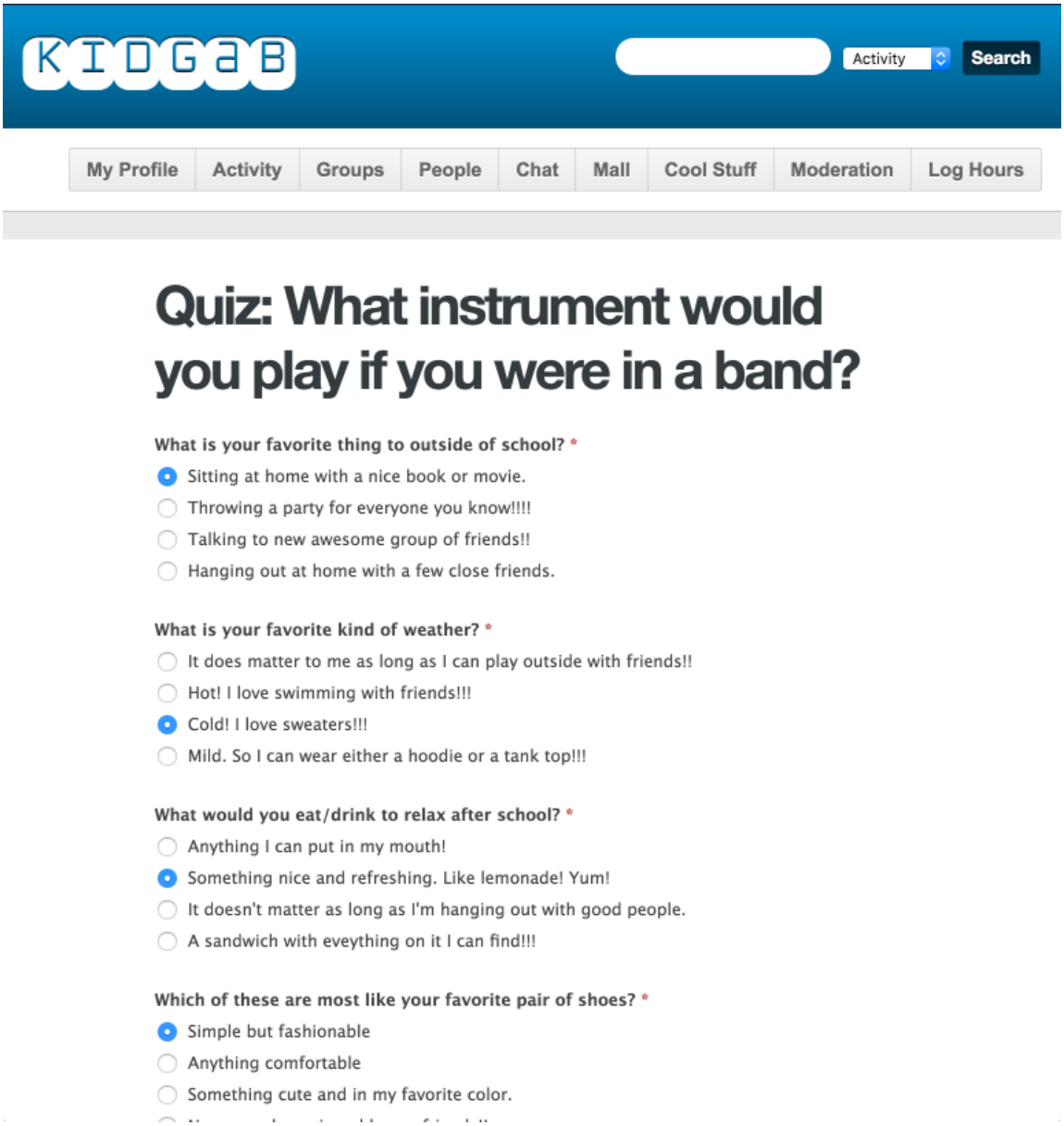


Figure 4.15: Screenshot of a quiz.

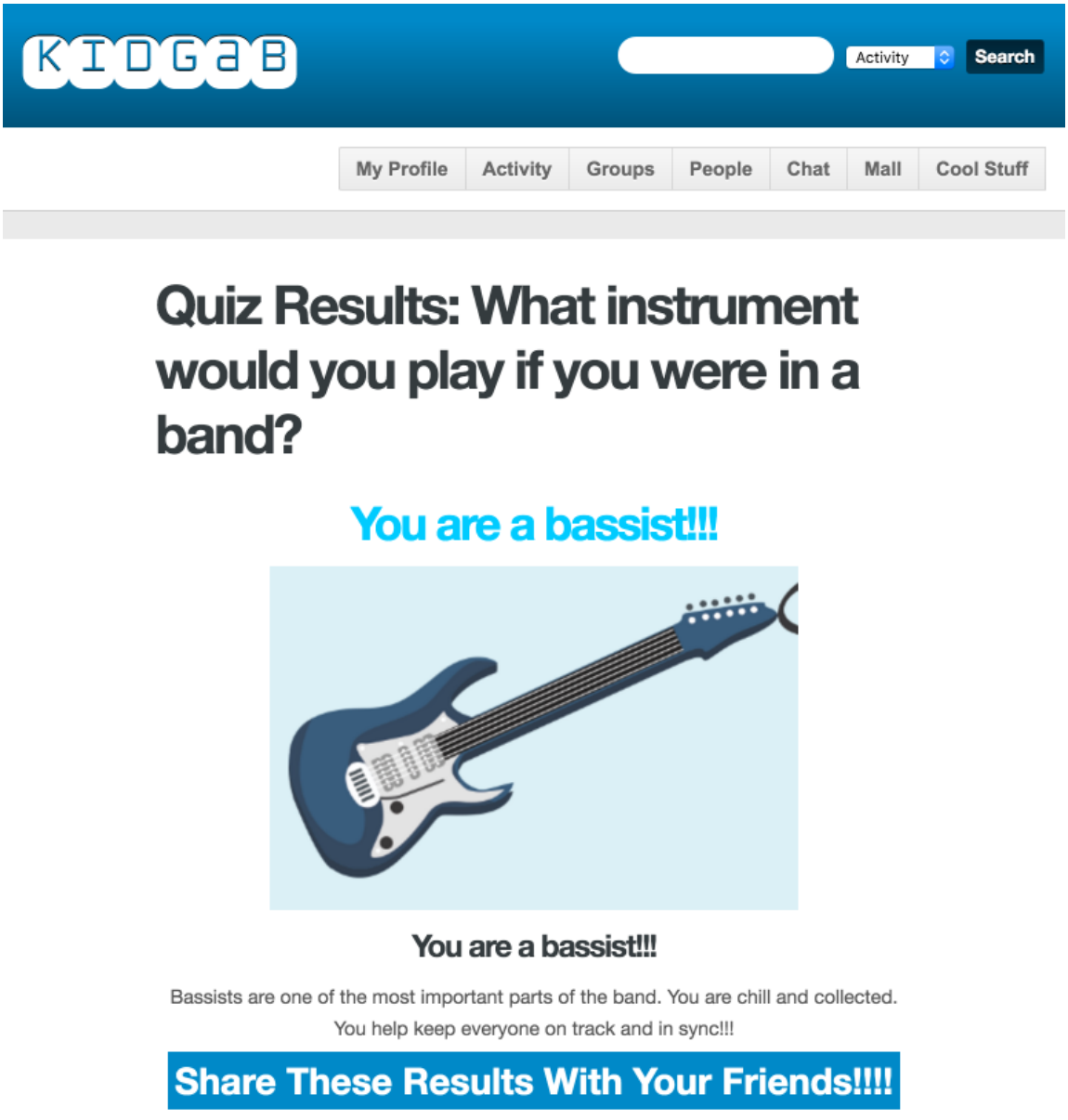


Figure 4.16: Screenshot of quiz results.

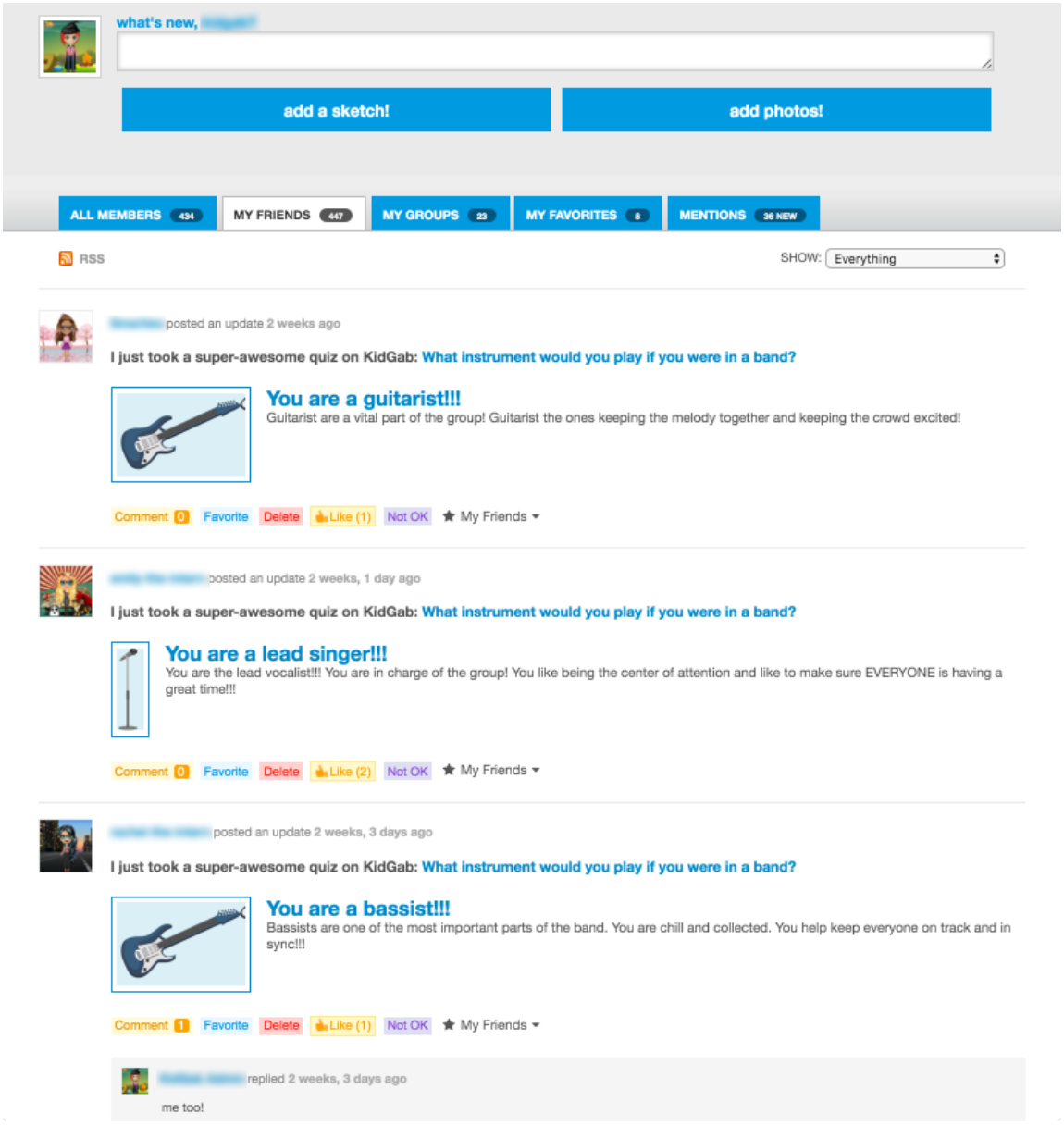


Figure 4.17: Screenshot of quiz posts.

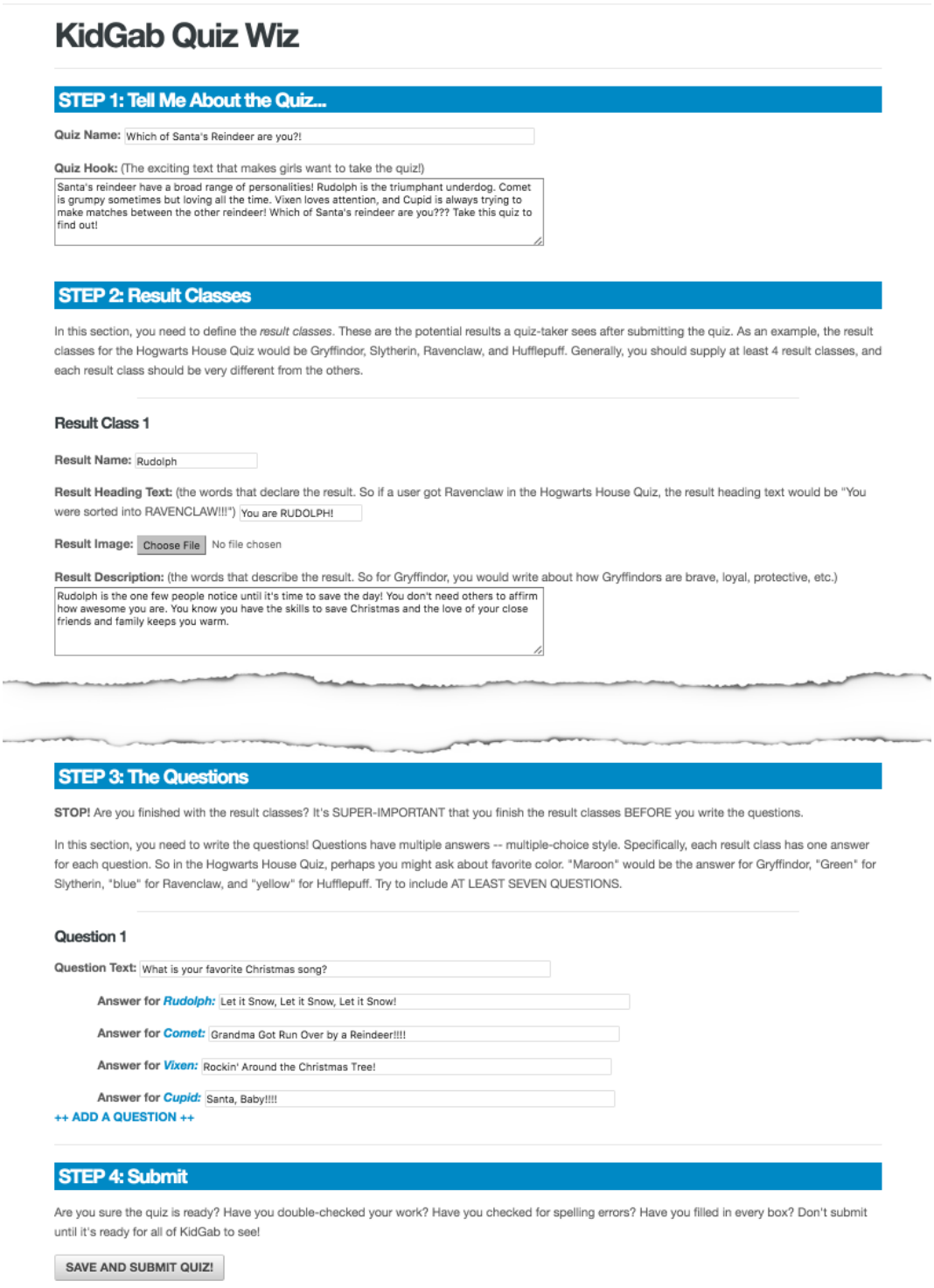


Figure 4.18: The KidGab Quiz Wiz.

determine a winner. Each result class should have an image, so the author would need to upload images on the media upload page. The URLs for the uploaded images should be recorded, because they are needed for the next step. Next, the author needs to create another new page that displays the result, the result image, and the result description, which requires several more JavaScript functions. Finally, the author must configure the first page to direct to the second page when the form is submitted. This process usually took in excess of 3 hours.

With the understanding that managing KidGab is a full-time job, we are devoted to simplifying extensive manual processes. From such ideas, the KidGab Quiz Wiz (Figure 4.18) was born. The KidGab Quiz Wiz (short for Wizard) is a single-page form which requires quiz authors to define only the creative materials: result classes, result descriptions, paths to result images, questions, and answers. All other functions, such as creating pages, writing scoring scripts, uploading photos, configuring form submission behaviors, etc. is handled internally by the Quiz Wiz. Once an author submits a quiz, the pages appear as drafts for an administrator to approve and publish. Once published, the Quiz Wiz automatically adds the new quiz to the list of all quizzes available for users to explore.

4.6.2 Use Throughout KidGab's Deployment

As of day 458, we have released 43 quizzes. The first quiz was released on day 90 of the deployment. In total, 54.07% of our users have taken 1,412 quizzes and posted their results 864 times. In the 369 days since the release of the first quiz, a user takes an average of 1.37 quizzes and posts 0.84 quiz results per daily session. Over all time, a user takes an

average of 5.74 quizzes and posts 3.51 quiz results. The five most often taken quizzes are:

1. “What is your spirit Animal?”, which has been taken 115 times;
2. “What’s Your Fashion Style?”, which has been taken 100 times;
3. “What Disney LEADING LADY are you?”, which has been taken 93 times;
4. “What PET should you own?”, which has been taken 92 times;
5. and “Which anime sidekick are you?”, which has been taken 85 times.

4.7 Sketching Quests

The Quest section of KidGab is slightly more contrived than the others presented here to collect a specific kind of data from our users: data regarding conformity. We will go into more detail regarding our conformity analysis methods in Chapter 6. In KidGab’s first (and currently only) quest, KidGab asks its users to help Princess Admin save her brother, Prince Dave, from the evil Wizard Toby. The Wizard Toby has disguised many essential items in the kingdom to appear just as they do in the girl’s imagination. The girl’s job is to draw what’s in her imagination to help the quest characters save the day. For example, the activity asks the girl to draw Prince Dave’s castle, a vehicle to allow travel to the castle, a sidekick capable of driving the vehicle, etc. There are 9 total sketches requested within the first quest activity. A screenshot from the quest activity can be found in Figure 4.19

4.7.1 Use Throughout KidGab’s Deployment

On day 143 of the deployment, we released the quest activity. Since then we have witnessed 53 users (19.56%) complete 351 total quest sketches. Each of the 53 users com-

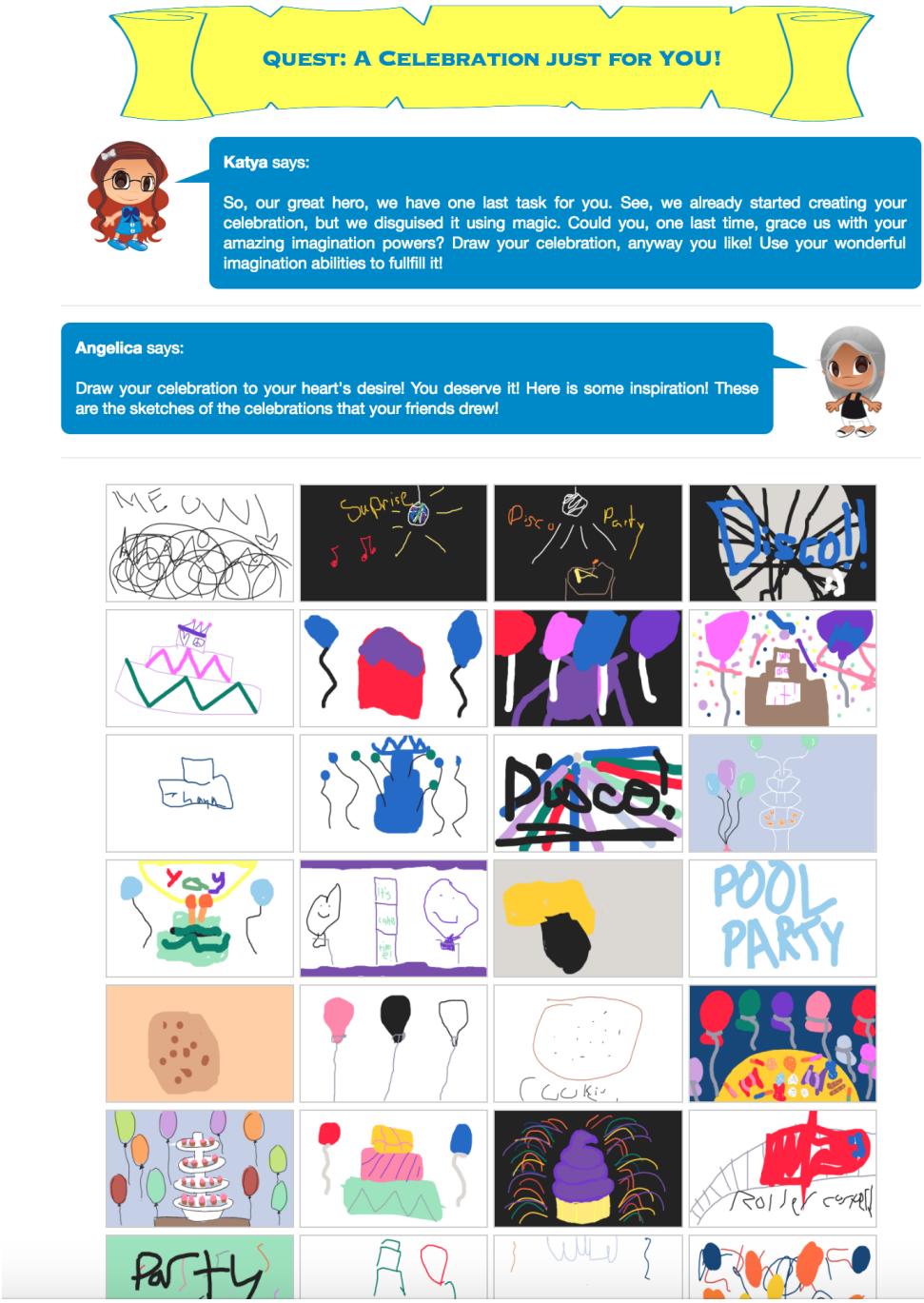


Figure 4.19: A screenshot from KidGab's quest activity.

pleted an average of 6.72 sketches. Further analysis regarding the quest activity can be found in Chapter 6.

4.8 Choose-Your-Own-Adventure Stories

This area of KidGab includes fictional stories about girls who find themselves in sticky digital situations. Users have the power to control the outcomes of the stories by making decisions for the characters as the plot progresses. The stories are authored by our research team and include facts from real news articles and court cases regarding cyberthreats (cyberbullying, online predators, plagiarism, dangerous email spam, etc.). This format of information delivery is particularly advantageous because it allows users to explore the consequences of poor decision-making without personally suffering those consequences.

An example Choose Your Own Adventure Story is "Kimberly's Story." In this story, Kimberly and her friend Iris are tempted to plagiarize while working on a school project. One potential path of Kimberly's story is shown in Figures 4.20 and 4.21.

4.8.1 Use Throughout KidGab's Deployment

Unfortunately, because Choose-Your-Own-Adventure stories do not generate digital records when a girl completes them, we have few quantitative statistics to report. One badge relates to stories: the Choose-Your-Own-Adventure badge. The instructions for this badge read: "To earn the Choose-Your-Own-Adventure Patch, explore some of the good decisions and the poor decisions made by each of our characters in the Choose-Your-Own-

Cyber Adventures - Kimberly's Story

Kimberly is a 13-year-old basketball star of her school's team. She has many dreams and goals for the future and she wants to someday play on a WNBA (Women's National Basketball Association) team.

Kimberly and her BFFL Iris were sitting in Kimberly's room, working on a science project for their school's science fair the next day. Unfortunately, because both girls had been really busy playing basketball, they didn't know what to do for their project.

"This is taking too long and it's so boring. I wish there was a way we could come up with an idea soon, I don't want to spend all day working on this," Kimberly told Iris, who was looking at a website on her laptop.

"I have an idea. What if we just copied a project from this site? It has everything we need and we don't have to do anything," Iris said, turning her laptop around to show Kimberly the website she was looking at.

How should Kimberly respond?

Option: 1
Sure, let's copy the project.

Option: 2
No way. I don't want to get into trouble.

Figure 4.20: One potential plot path for Kimberly's Story.

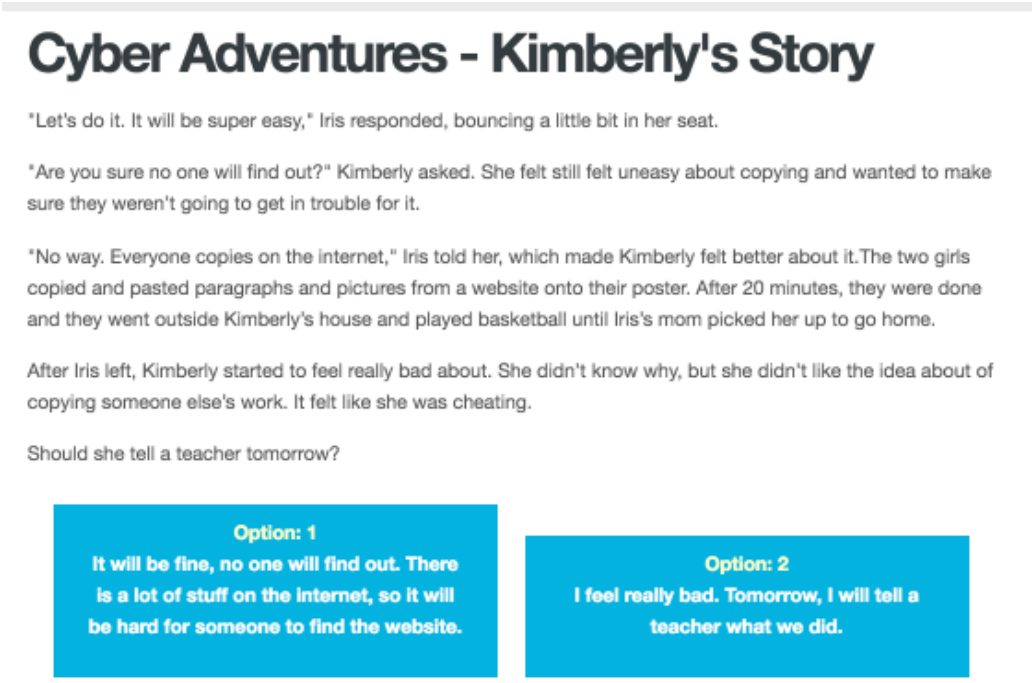
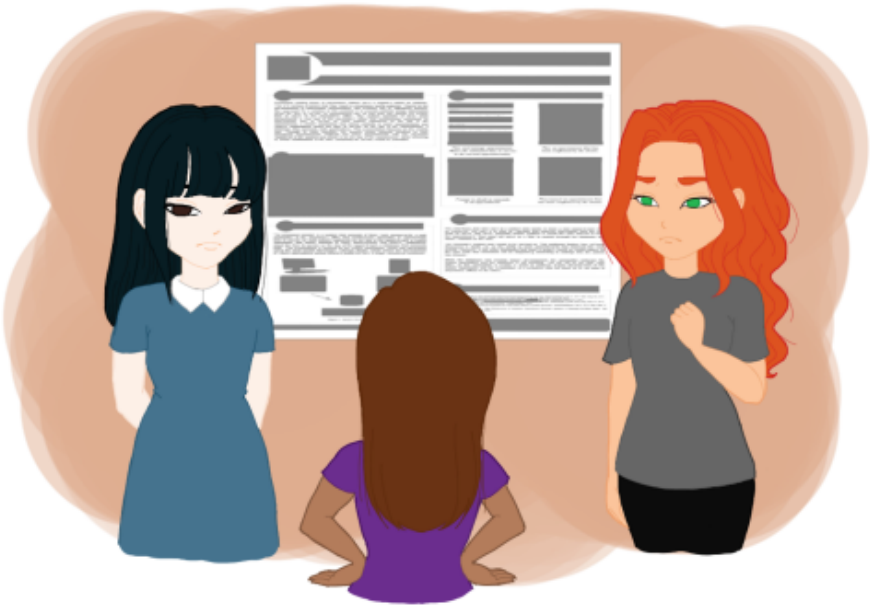


Figure 4.21: One potential plot path for Kimberly's Story. The user chose the first option on Screen 1.

Cyber Adventures - Kimberly's Story



The next day, at school, Kimberly and Iris showed the school their poster. One of their teachers, Ms. Dee walked up to the two girls, looking angry.

"Do you girls know what you did?" Ms. Dee asked the two girls.

"No. What did we do?" Kimberly and Iris asked at the same time. Kimberly began to feel worried. Did Ms. Dee realize that they had copied their project?

"You girls plagiarized, didn't you?" Ms. Dee asked them, bending down with a stern look on her face.

"What does plagiarized mean?" Kimberly asked.

"Plagiarize means to take someone's work and say that you did it. Everything you have on your poster came directly from a science fair website. I don't see anything that YOU actually created on your own on your poster," Ms. Dee explained.

Option: 1
Continue Kimberly's Story

Figure 4.22: (Continued) One potential plot path for Kimberly's Story. The user chose the first option on Screen 1, and the second option on Screen 2.

Figure 4.23: (Continued) One potential plot path for Kimberly's Story. The user chose the first option on Screen 1, the second option on Screen 2, and the first option on Screen 3.

Adventure area of KidGab! When you finish exploring, write one cyber-safety tip you learned from the stories and use hashtag #adventure!" Thus far in KidGab's deployment, 9 girls have earned this badge, but this number hardly signifies the popularity of Choose-Your-Own-Adventure stories considering the relatively low popularity of badge activities.

Further, we have anecdotal evidence that the girls like the Choose-Your-Own-Adventure stories, and that the activity is effective in making girls feel the consequences of poor online decision making. In an online chatroom conversation with one of KidGab's users, we asked which Choose-Your-Own-Adventure story was her favorite. She replied that she enjoyed Kimberly's Story the best. The user had experienced something similar to what Kimberly goes through in the story and she felt that the story was very realistic. In a chat conversation with another user, we asked whether she liked a story we had just released (Sarah's story, which is about two best friends that get into a fight and one cyber-bullies the another in anger). The girl commented "i liked it but... it almost made me cry." This sentiment, indicative of several others we've received, shows that the stories elicit an emotional reaction from our young readers.

In our #DigitalFriendship workshops, we take about 20 minutes for the girls to explore one story (two stories if they read quickly). We generally instruct them to read Katie's Story, which centers around a girl whose crush pressures her into cyberbullying a schoolmate. We encourage them to take an alternative path to the one they consider to be "correct" and to be curious about "what would happen if..." scenarios. After the 20 minutes had elapsed in a workshop on December 5, 2015, one girl raised her hand to say,

"I tried to make the 'wrong' choices, but then I felt too guilty. After that I started making the right ones." This girl's comment speaks to the effectiveness of the stories in teaching girls the consequences of online decision making. The girl felt herself in the shoes of the character — responsible for the character's character's decision-making. The girl who made this comment, and the many other girls who have read the stories, have learned the consequences of poor online decision making without suffering from the dangerous consequences themselves.

4.9 Moderation Techniques

Like any social network, the goal of KidGab is to grow to accommodate many users, many more than 271. In order for KidGab to be prepared to meet that goal, it requires an affordance of moderation — a process for users to actively participate in maintaining the site's safety. From such ideas, the "Not OK" button was born.

On the front end, we created a button below each activity post labeled "Not OK" (Figure 4.24(a). When clicked, a color wheel with four options appears: 1.) 'mean', 2.) 'not for kids', 3.) 'copycat,' and 4.) 'other'. When a user flags a post as "Not OK" (Figure 4.24(b)) it is hidden from the site activity feeds for all users, save admins and the post author. Additionally, both site admins and the post author are notified that the post has been flagged as inappropriate. The post appears on the admin- and mentor-only "Moderation" page, accessible from the main navigation menu, as seen at the top of in Figure 4.25. On the moderation page (also Figure 4.25), the moderator can complete one of two actions for

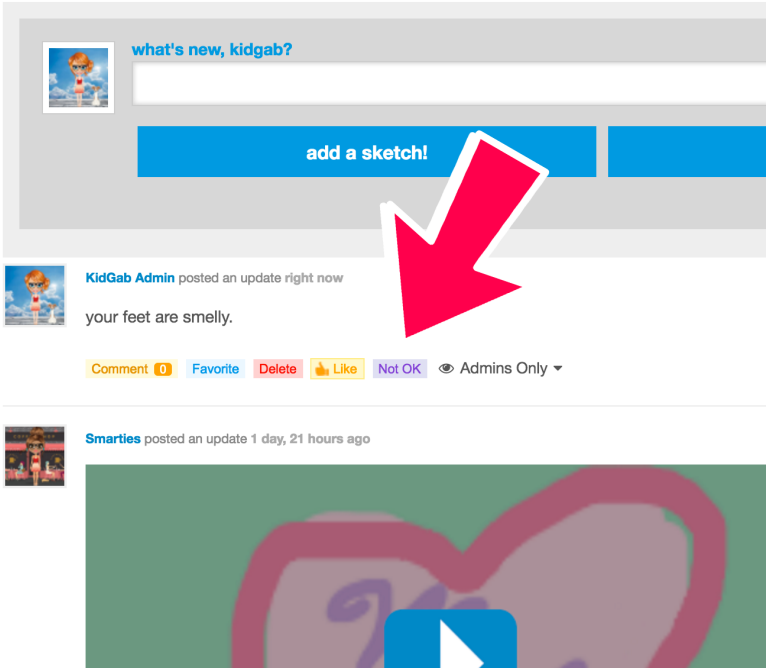
each post: hide the post, or deem it appropriate. In either case, the moderator can include a message for the reported user. This message is generally intended to educate the users on how they might have communicated their message in a more appropriate way.

4.10 Parental Monitoring Techniques

With a wide range of communication modalities available to children, it was imperative that we provided an interface to summarize the vast, noisy, unstructured and dynamic communications that happened on a daily basis to increase the ease of monitoring site activities. This vastness of the data may make it difficult for a parent or administrator to track and identify changes in activity patterns and unusual activity trends for each child. Example unusual activity trends might include a child who is active on KidGab that all of a sudden stops interacting, or a surge of incoming posts compared to outgoing posts for a child. The mentors and parents need to be alerted in the above situations. Therefore, we designed and built an activity analysis system for admins, mentors, and parents. Below, we describe our designs for the front-end component of our monitoring system.

The monitoring information KidGab provides is organized for each individual child and visible from the ‘Monitor’ tab of the user profile page. Upon accessing the child’s ’Monitor’ tab, the monitor will see the four category options: ‘Overview’, ‘Posts’, ‘Comments’, and ‘Communication’. A monitor can access the different categories by selecting any one of the button options. By default, the button selected will be ‘Overview’. Figure 4.26 shows the four buttons in the ‘Monitor’ tab for KidGab Admin’s profile page.

(a)



(b)

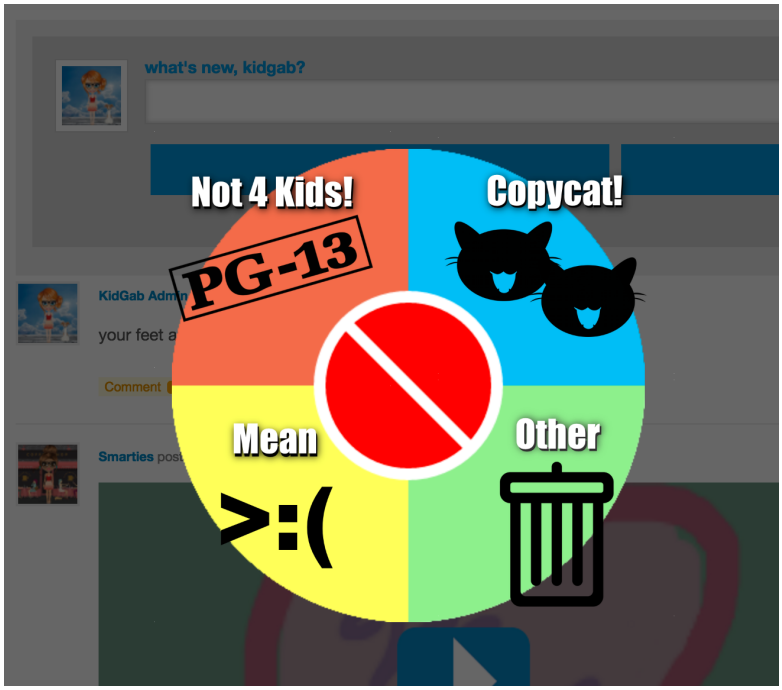


Figure 4.24: Screenshots of KidGab's moderation button and Not OK menu.

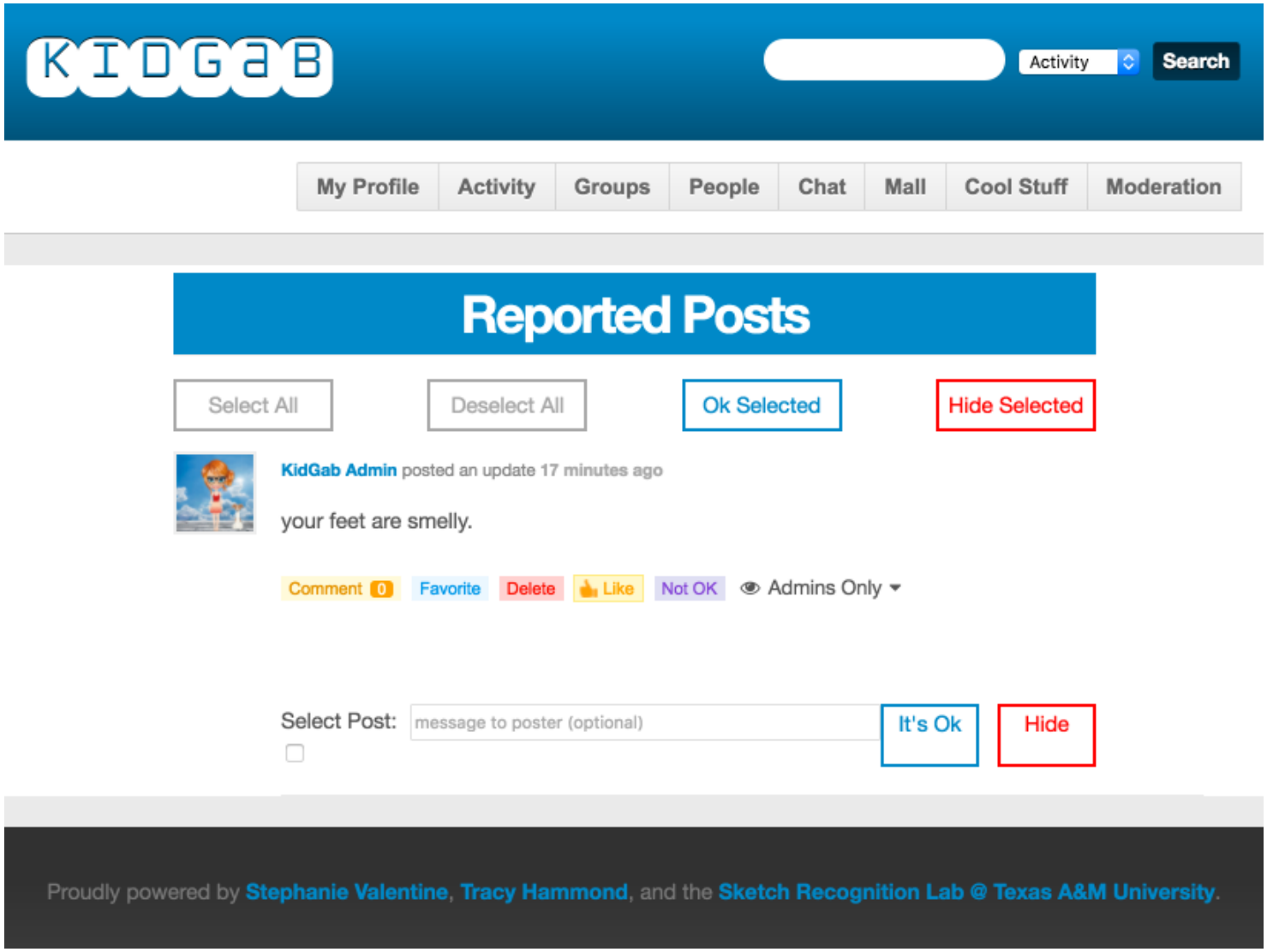


Figure 4.25: KidGab's moderation page.

Within each category, the section displays a bar graph summarizing the data for that specific category. Data within each graph is organized by time period: 'Today', 'Yesterday', 'Past 7 Days', and 'Past 30 Days'. Figure 4.26 shows the bar graph displayed in the 'Overview' section. The data is organized by time and currently displays the data for 'Posts', 'Comments', and 'Communication' as it is not yet connected to display the data for 'Time'. Furthermore, each category is visually represented by hue. 'Posts' is designated a coral hue color; 'Comments' has a green hue; and 'Communication' is assigned a purple hue. Separate color hues for each category help the user to better process the information. Located under each graph is a 'Show/Hide Table Data' button. Clicking that button will either show or hide the table containing the average values of the data for the bar graph. By default, the table data will be hidden.

The information in 'Posts', 'Comments', and 'Communication' is further organized by two categories: to user (incoming) and by user (outgoing). The information is separately summarized through two columns under each graph. In the 'Posts' section, for example, the information of posts written to the child and by the child can easily be viewed as seen in Figure 4.27. The left column under the graph shares posts by user and the right column shares post to user. The summary is organized by time period for each column and shares the number of posts made within that time period. In addition, each time period ('Today', 'Yesterday', 'Past 7 Days', 'Past 30 Days') is a hyperlink. The user can further click the link to expand and collapse the section to view the posts that the child wrote. Upon clicking the hyperlink labeled as 'Today', the user can see any posts made today by that child.

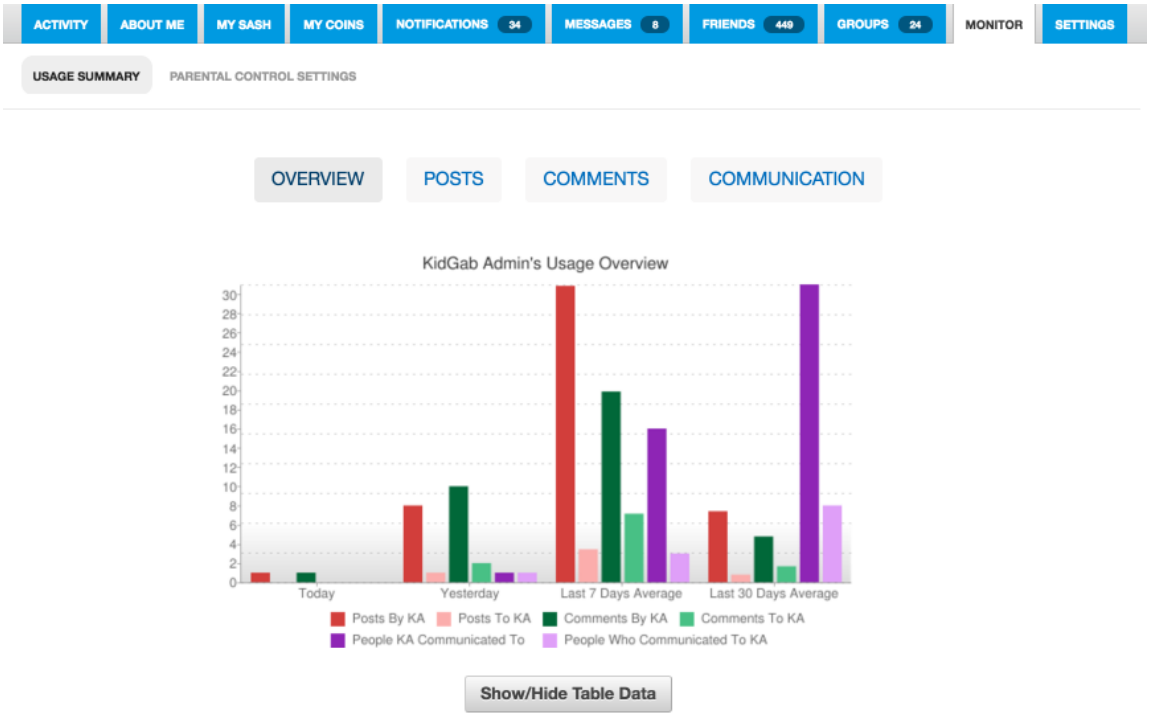


Figure 4.26: KidGab's monitoring system, accessible only by parents and admins, provides a quick overview of a child's site activities.

Figure 4.27: KidGab's monitoring system provides an overview of activities for both incoming and outgoing posts.

The ‘Communication’ section shares a similar page structure as ‘Comments’ and ‘Posts’. The left column displays the count of users the child communicated to and the right column displays the amount of people who communicated to the child. Like the ‘View’ hyperlink in the ‘Comments’ section, the user can see additional information about the communications made by clicking the ‘View Conversation’ link. Clicking the link will take the monitor to a new page that shows all of the comments and posts made between the two users requested. Figure 4.28 shows the ‘View Conversation’ link in the expanded section of the Communication page, and Figure 4.29 shows the communications between the two users.

In addition to this information, the system is designed to display a flag at the top of the ‘Monitor’ page when needed. The system tracks the ratio between incoming and outgoing behaviors for today and yesterday. Whenever there is a drastic change in ratio between incoming and outgoing or a change in today and yesterday, the child will be flagged. Figure 4.30 shows that Stephanie Valentine was flagged because both her ratio of incoming and outgoing posts for today and yesterday spiked. The user viewing Stephanie’s activity summary section will immediately see the flag and can take further action to pursue if there is any illicit activity occurring such as bullying.

4.11 Conclusions & Contributions

In this chapter, we described the features, affordances, and usage of our custom-built social network for children, KidGab. KidGab is an example of a site built using the

Figure 4.28: KidGab allows parents, mentors, and admins to keep track of the users a child has communicated with online.

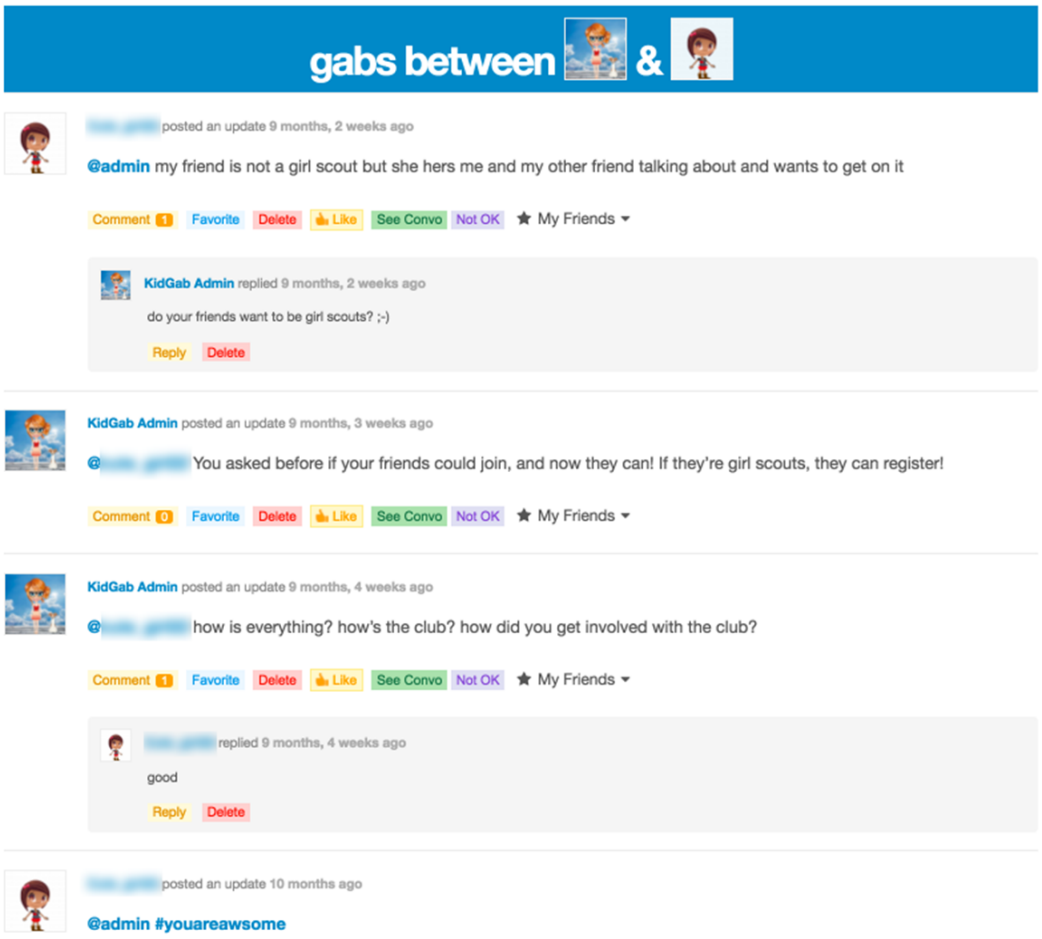


Figure 4.29: KidGab allows parents, mentors, and admins to easily read communications between any two (or more) users.

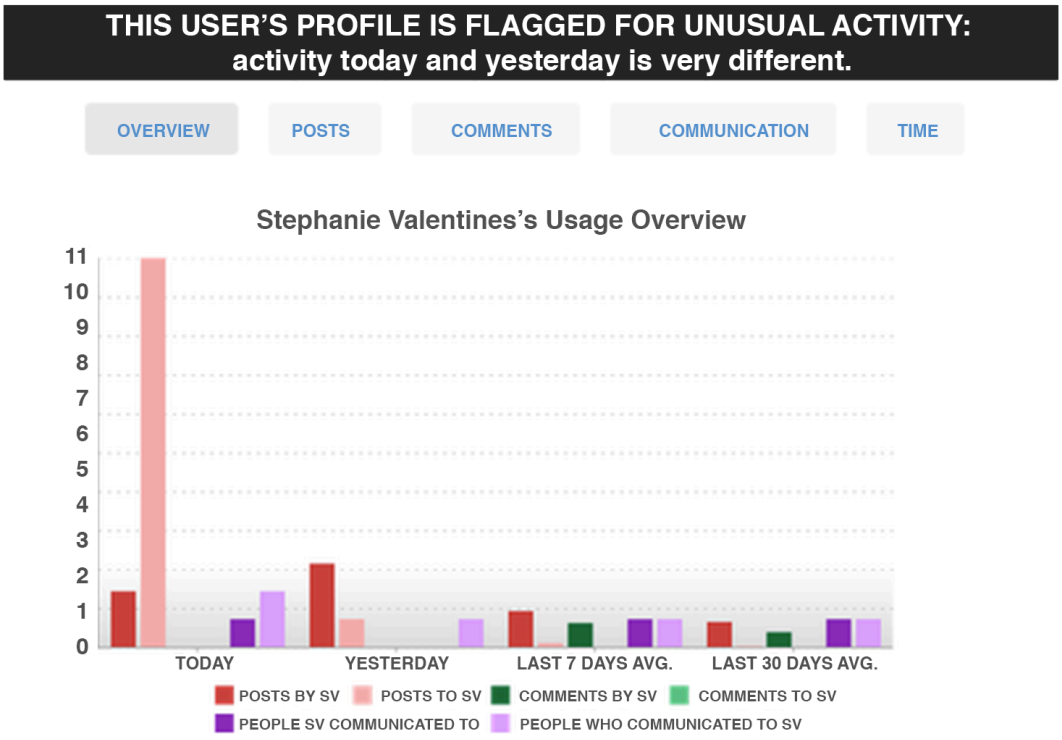


Figure 4.30: This user's account was flagged for unusual activity.

considerations provided in Chapter 3, but has also been inspired and iteratively improved throughout its experimental deployment. In the next section, we provide more details regarding our 458-day deployment with the Girl Scouts of Central Texas.

5 DEPLOYMENT

5.1 Participants

This work focuses on girls for a number of reasons. First, although early studies on cyberbullying have suggested that cyberbullying is more common among boys (as victims and perpetrators) [116], more recent studies have shown that girls are more likely than boys to be victims [213], in particular when the age range in the study is limited to middle school students [99]. KidGab not only offers a safe space for girls to participate in social networking, but also teaches them digital citizenship through engaged activities. Second, research has shown that among preadolescents, girls are more interested in social networking than boys [160]. KidGab takes strategic advantage of this interest while allowing girls to explore their identities. This is important since studies have shown that identity exploration is a central component of adolescent girls' online behavior [132]. KidGab offers an arena to understand how girls in a younger age bracket explore their identity online. Finally, there is a glaring disparity between the number of girls versus boys engaged in the Science, Technology, Engineering, and Mathematics (STEM) fields [86]. A social network for girls where they are able to create, as opposed to only share and post information, has the potential to attract girls at a young age to the STEM fields.

For initial deployments of KidGab, we chose to engage an existing community of active and connected children, the Girl Scouts organization with whom we have a collaborative history.

5.2 Ethical Considerations of Consent/Assent

Consent from parents and assent from girls are vital to adhere to both United States federal laws and the strict standards of research integrity set by ourselves and our university. The informed consent/assent process for this research includes two forms. First, parents must read and sign a three-page consent form outlining expectations of the participants, the types of data we will collect, our data management plan, a release to record video, the minimal risks involved with participation, and the benefits of participation to the parents, girls, and society. Second, girls receive and must sign a one-page assent document explaining the project, participant expectations, and data collection. Researchers are available in person, by phone, and by email to answer any consent/assent questions from either guardian or girl. Both forms have been approved by our institutional review board and are subject to annual review.

5.3 Recruitment of Participants

5.3.1 #DigitalFriendship Workshops

The first stage of our KidGab deployment is the four-hour Digital Friendship Workshop, an original workshop curriculum developed to teach kids and families how to create and keep healthy digital relationships. The Digital Friendship workshop focuses on the transition from friendships in the physical world to friendships in the digital world.

At the start of the workshop, we focus the curriculum on individual personality preferences. Each girl fills out the True Colors personality test [16], a modified version of

the standard Myers-Briggs personality test [142]. After the girls complete their personality tests, each girl will receive scores for each of four personality types (each type is a color: Blue, Gold, Orange, and Green). The color with the highest score is considered to be the girl's primary personality type. We group the girls by personality color and ask each group to create a poster about their friendship preferences, answering questions such as "Three words to describe us are...," "We like it when our friends...," "It annoys us when our friends...," etc. The girls present their posters to the whole group.

Next, girls continue to explore their own friendship styles by creating Digital Friendship bracelets. To start, we provide each girl a piece of string. Girls add beads of specific colors to the bracelet according to their beliefs. For example, we pose the following question to the group: "When I send a text message and my friend doesn't respond right away, I...". Then, we invite the girls to add a purple bead if they would "text her again asking why she isn't responding," add a blue bead if they would "check my phone every few minutes until I hear from her", etc. At the end of the activity the girls compare their bracelets with one another and see that the color patterns on all the bracelets are different. Examples of Digital Friendship bracelets can be seen in Figure 5.1. The lesson we try to convey with this activity is that each person and each digital friendship is unique. We added this activity to the workshop in the second deployment to replace a slide show presentation detailing the True Colors results.

Next, we engage the girls in discussion about cyberthreats (cyberbullying, online predators, over-sharing, etc.) and other online trivia (use of hashtags, HTTPS, intellec-

Figure 5.1: Example Digital Friendship bracelets.

tual property, etc.). In the first deployment, this conversation was aided by a NetSmartz[1] slide show presentation and in the second deployment it took the form of a bingo game. Following the cyberthreats conversation, the girls split into groups and prepare skits about strategies for handling specific cyberthreats.

At this point, we give the girls an interactive tour of KidGab. Girls make avatars, chose themes, update their profile information, earn badges for their digital sashes, practice sending messages to one another, etc. Parents are invited to join their daughters for this part of the workshop.

The workshop's capstone activity empowers the girls to explore the consequences of online decision-making. In a special section of KidGab, we constructed several fictional choose-your-own-adventure-type stories, which allow children to make decisions that influence the character's path. For example, in "Katie's Story," Katie is pressured by her crush, Jason, to make mean comments about another boy in their class. Each girl gets to decide whether Katie posts the mean comments or whether she attempts to resist the peer pressure, and the story changes accordingly. Because we worried that girls would always try to choose the "right" path and thus miss the point of the exercise, we designed the sto-

[1] http://www.netsmartz.org/

ries such that even "good" decisions lead to interesting plot twists. Even if a girl chose for Katie to resist peer pressure, the next chapter in the story details how the peer pressure eventually overpowers Katie, and she posts the mean comments anyway. What should Katie do now? All the stories are fictional, but we included situational details from real cyberthreat scenarios (found in news articles, books, etc.).

Following reflection discussions on the Choose-Your-Own-Adventure stories, the group fills out workshop evaluation surveys, establishes guidelines for participating on the site (e.g. no cyberbullying, be a sister to every Girl Scout, etc.), and the workshop concludes.

5.3.2 Online Registration

Beginning on day 140 of the deployment and with the approval of the TAMU IRB, we enabled online registration on KidGab. The online registration process requires parents and girls to register at the same time, each providing their desired account information and providing their consent/assent with a digital sketched signature. One parent can register with any number of girls. Each girl requires a twelve-digit Girl Scout Membership Identification Number to prove she is a Girl Scout. Additionally, each girl can select from a list of options, such as those at the bottom of Figure 5.2. When such options are selected, the girl automatically becomes friends with the other users whom have selected that option (the other users in the cohort) and automatically added to the cohort's group page.

Adults cannot register independently — all adult accounts not attached to a girl's account with a parent-child relationship need to be manually created by a site administrator.

By day 458 of the deployment, a total of 87 users have registered for KidGab using the online registration feature.

5.3.3 Summer Camp Outreach

In the summer of 2015, we visited a Girl Scout Summer camp near Austin, TX to introduce KidGab to the campers. KidGab, we reasoned, would be a great way for the girls to keep in touch with one another after they leave camp. We presented KidGab to approximately 25 girls in two separate one-hour sessions. Due to extenuating circumstances regarding logistical considerations, we decided that physically attending camp was undesirable. Instead, we hurried along the online registration procedures and invested in promotional materials. We ordered glow-in-the-dark wristbands in KidGab's trademark blue color with the words "kidgab.net" and "i <3 my digital friends" embossed upon them. We refer to these as the "glow-in-the-dark bracelets" to alleviate confusion between these and the Digital Friendship bracelets, described above. To each bracelet, we added a business-card sized explanation of KidGab for both girls and parents (see Figure 5.3. The camp we visited (and one other in the Waco area) agreed to hand out the bracelets at as the campers check out with their parents.

5.3.4 Other Recruitment Opportunities

We have executed several other recruitment strategies with the help of the Girl Scouts of Central Texas (GSCTX). The most elaborate of these is the "Patch of the Month." Each month, GSCTX sponsors a "Patch of the Month": they upload a patch curriculum to their website, and troops or individual scouts can choose to earn the patch. In December 2015,

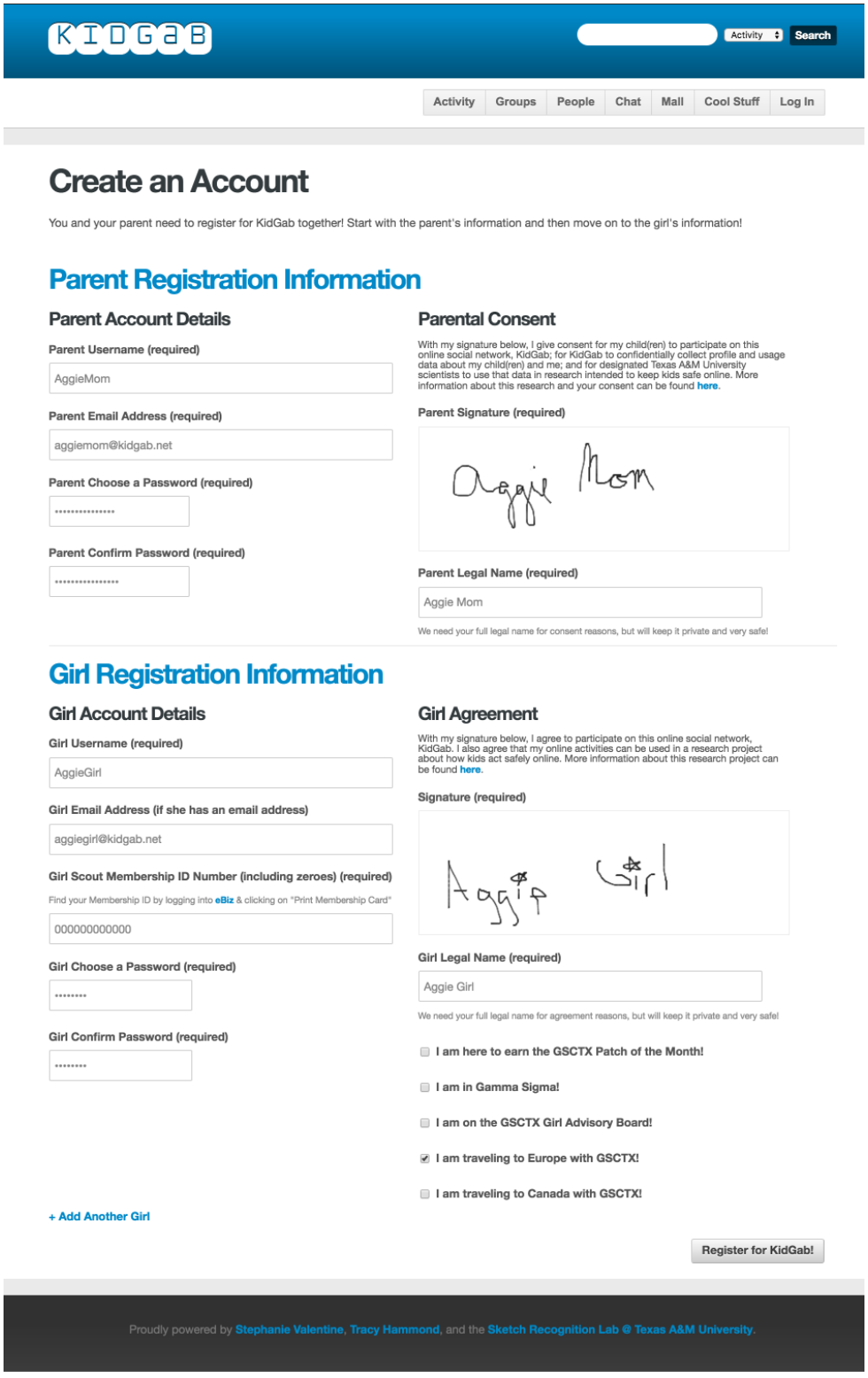


Figure 5.2: Screenshot of KidGab's online registration and consent/assent form.

Figure 5.3: KidGab's glow-in-the-dark promotional bracelets.

Figure 5.4: The #DigitalFriendship patch.

the GSCTX Patch of the Month was #DigitalFriendship. To earn the patch, the Girl Scout needed to familiarize herself with KidGab (make an avatar, choose a theme, etc.), complete the quest activities, earn badges, and take quizzes. Total, 43 girls registered with an intent to earn the patch of the month. The #DigitalFriendship patch can be seen in Figure 5.4

Other unique recruitment opportunities we have partaken in include:

- attending several Girl Scout sponsored events (for example, Girl Scout Stem Fest 2015 and 2016) and presented KidGab to attendees at a promotional booth;
- providing a content-management space for several girl-led organizations within

GSCTX, including the Girl Advisory Board;

- collaborating with the GSCTX Travel Specialist in an effort to provide KidGab as a means for girls to get to know one another and to organize information before embarking on their journeys;
- and providing the Girl Scout shops in both Bryan/College Station and Austin with buckets of glow-in-the-dark bracelets to provide to their customers free with purchase.

5.4 Data Collection on KidGab

Once a girl has been recruited to the site, we attempt to track each activity she in which she chooses to partake. The KidGab system has built-in usage trackers that maintain a log of nearly every activity that happens on the site. For each user, we have a record of each time a user completes the following activities:

- logs in
- logs out
- creates a Friendship
- dissolves a Friendship
- posts an update
- posts a comment
- sends a private message
- deletes an update
- deletes a private message
- likes a post
- changes her password
- forgets her password
- completes a survey
- changes her avatar
- changes her theme
- earns a badge

- takes a quiz
- posts a quiz
- purchases an item from the mall

In the following chapters, we discuss how we leveraged this significant amount of data to answer questions regarding children's online social networking behaviors.

6 MEASURING THE PROPENSITY OF CHILDREN TO CONFORM TO OTHER'S IDEAS ON ONLINE SOCIAL NETWORKS

Cyberbullying, defined as "[w]illful and repeated harm inflicted through the use of computers, cell phones, and other electronic devices" [68], is a digital phenomenon affecting a significant portion of our youth. Research into cyberbullying victimization rates indicate that as many as 36% of children in middle school (ages 12-14) have been victims of cyberbullying [73]. In a 2010 survey, Microsoft found that 40% of parents said their child was involved in a cyberbullying incident and that 76% of educators rank cyberbullying as a "severe" issue [138]. There is an ever-growing body of research regarding contextual factors and cyberbullying victimization/perpetration rates. Are such rates influenced by gender [213, 99]? By family structure [192, 50]? By socioeconomic status [105, 200]?

One factor of particular interest to this work is the role of peer influence and conformity on cyberbullying behavior. Researchers such as [83, 69, 51] report a connection between peer group structure and cyberbullying behavior. Juvonen [83] shows that negative, antisocial social mimicry can be predicted among preadolescents when one child has an unreciprocated attraction to another child. Simply, if child A wants to be friends with child B, and child B cyberbullies, then it can be predicted that child A cyberbullies, too. Festl and Quandt [51] reported that where much bullying occurs among teens, much cyberbullying occurs also. Hinduja and Patchin [69] report that young people who believed

many in their peer group engaged in bullying and cyberbullying activities were more likely to engage in cyberbullying behaviors themselves. Thus, prior research indicates that bullying, cyberbullying, and peer influence go hand in hand. Identifying those children most susceptible to peer influence and conformity on social networks, then, may be the first step in cracking down on group cyberbullying behavior.

6.1 Background

The following sections introduce the ideas of peer influence and design fixation.

6.1.1 Peer Influence & Conformity

Peer influence and conformity can be observed as early as in preschoolers, and these behaviors become increasingly salient and heightened in adolescence [194]. Peers often serve as a reference group, with peer crowds defining the social norms and standards in group contexts that create perceived and actual pressures to adopt the styles, values, and interests of peers. Failure to conform often results in social, emotional, psychological, or physical consequences such as being ignored, rejected, or bullied. Fitting in and going along with the crowd to avoid punitive consequences could also lead to group-think that stifles autonomous development, including creativity and originality. While researchers are beginning to examine crowd design and crowd creativity [220], including collaborative fixation or group-think [95], there has been no published research on the role of peer influence and conformity on design ideation processes of children and adolescents in online environments.

Studies have identified potential factors, including demographic factors, that make people either more susceptible or more resistant to peer influence and conformity [20]. For example, trendsetters (highly influential peers) are likely those who possess characteristics or enact behaviors that garner (positive or negative) attention and reactions from the peer group. Those who identify or affiliate with a highly visible group are more susceptible to conforming to group norms and behaviors. Relationship qualities such as friendship reciprocity as well as intimacy and closeness amongst peers determines whether one is more susceptible or more resistant to peer influence and conformity [20].

In offline contexts, peer influence and conformity appear to be linked to attitudes and behaviors of high-status peers. Peer status is often conceptualized as a reputation-based construct reflecting dominance, positions on the social hierarchy, and access to (physical or social) resources. Affiliation and exposure to the attitudes and behavioral norms of the high-status peers (e.g., peer-perceived popularity) are linked to endorsement or engagement in attitudes and behaviors of the high-status peers [36, 83]. In contrast, research indicates that failure to conform with social norms of high-status peers is linked to social punishment, including social exclusion and rejection by peers [82]. Particularly for adolescents, youth are likely to engage in behaviors that have been established by admired peers in order to gain acceptance and approval that then contribute to a self-concept or self-identity [191].

6.1.2 Cognitive Fixation

Cognitive fixation can be defined as a potentially surpassable block or impediment to completing a mental excercise — something that prevents one from completing cognitive operations, such as those in memory, problem solving, and creative ideation ((e.g., [30, 79, 157, 186, 185]). Prior research indicates that providing subjects examples or hints prior to creative idea generation tasks, people have difficulty thinking past those hints, often incorporating them in their own ideas [107, 188]. This tendency to be fixated on examples is a conformity effect. These conformity effects exist even when subjects are asked to deviate as far from the provided examples as they possibly can.

Conformity is a measurable construct, as evidenced by many published accounts using adults as subjects [30, 79, 157, 186, 185, 107, 62, 183, 87, 181, 135]. How, then, can we study peer influence and conformity on social networks for children? How might a social networking platform — which is an equal partner in the social networking process [12] — understand these behaviors differently? Social networking platforms have a log of every profile photo change, every comment, every password change, and every other action a user completes on the network. Might cyberbullies have a distinct signature of recorded online behaviors that set them apart from other children? In this chapter, we attempt to address that very question using data collected from our own social networking site for children, KidGab.

6.2 Method

In this work, we explore peer influence and conformity as displayed on an online social network for children. We collected our data using a custom social network for youth aged 7-13 years, KidGab. To summarize Chapter 4, KidGab is a private, community-based social network designed specifically for children, mentors, and parents. Taking hints from the methodologies of cognitive and design fixation experiments (e.g., [188, 88]), we provided an activity on KidGab that prompted KidGab users to generate and sketch creative ideas. For some prompts, we provide prior examples of ideas and on others we don't provide any examples. Should our results be consistent with prior research, the primed prompts should generate quite a bit more conformity than the unprimed. To this, we add a social component. If users know *who* came up with a specific idea, are they more or less likely to conform to it?

The hypotheses we explore in this work are:

- Conformity can be identified on social networks for children.
- Conformity on social networks for children increases with the introduction of identity identifiers.
- There exist specific participatory and behavioral traits which distinguish highly conforming, highly influential, and highly unique users.

6.2.1 KidGab

We collected the data used for this analysis on our custom social network for children aged 7 to 13 years, KidGab. KidGab has a roster of 271 users between the ages of 7 and 16

years (a few older girls have opted to attend #DigitalFriendship workshops, but are rarely active thereafter). The mean age of our user base is 11 years.

6.2.2 Data Collection Procedure

In order to test conformity on a generally unstructured social network in which most actions and communications are made autonomously by users, we required an online environment within which we could control the forces of priming and the sources of conformity. Inspired by S. Smith et al.'s conformity experiment [188], we designed a KidGab plugin that presents a digital adventure — a "quest" — to KidGab users and asks them to draw elements of the story to aid the characters in their quest. The storyline was presented in the style of a dialogue between two characters (the second and third authors), both moderators of KidGab with whom the girls should be familiar.

The quest storyline proceeds as follows: Princess Admin of Abalasia is in trouble. Her brother, Prince Dave, has been kidnapped. Evil Toby the Wizard disguised Prince Dave's **castle** to appear exactly as it appears in the participant's imagination. The two narrators are ready to find the castle, but the horses are on vacation and they need an alternative **vehicle**, a vehicle immune to any evil spell. The narrators unfortunately cannot drive the vehicle and thus need a **sidekick** to drive. The sidekick drives the vehicle to the castle. In the excitement, Narrator 1 runs off and gets captured by a **creature**. Narrator 2 suggests that before saving Narrator 1, the whole rescue team needs cute and functional **battle outfits**. Despite the outfit, the creature cannot be thwarted without a **weapon**. The weapon fails and nothing but the strengthening effects of a magical **object of power** can

ideation prompt	priming method	admin-determined attributes	admin-provided priming examples
castle	unprimed	— —	— —
vehicle	non-socially primed	article of clothing; wings	  
sidekick	socially primed	pop. culture reference; words	 admin  katya  angelica
creature	non-socially primed	green creature; bloodshot eyes; wearing shoes	  
battle outfit	socially primed	rainbow element; high heels	 admin  katya  angelica
weapon	unprimed	— —	— —
object of power	socially primed	item of jewelry; metallic component	 admin  katya  angelica
reward	unprimed	— —	— —
celebration	non-socially primed	balloons; sweets; blue background	  

Table 6.1: Prompts, priming methods, pre-determined attributes, and priming sketches.

defeat the creature. The rescue team defeats the creature, who then transforms into Prince Dave. Pinned to Prince Dave is a note for the rescue team informing them to fetch their **reward** from a treasure chest. The rescue team returns to Princess Admin's castle, where there is a great **celebration**.

We released three prompts on each of three consecutive days for a total of 9 prompts. Each day, we released one prompt with no examples (unprimed); one prompt with examples, but no identity markers (non-socially primed); and one prompt with examples and identity markers (socially primed). The priming examples are the complete set of responses from the user's friends and other users on the site. We intentionally counter-balanced the unprimed, non-socially primed, and socially primed activities in order to avoid any effects of activity ordering. Each day (each set of 3 drawing tasks) proceeded in a different priming order. The specific drawing tasks and the methods of priming are depicted in Figure 6.1.

In the priming cases, the research team submitted the first priming examples for the activity. The research team agreed on attributes to include in the first priming images for such activities (see Figure 6.1). This ensured that all participants were primed with examples and allows us to observe whether girls would conform to the ideas posed in our examples, whether they would conform more to the ideas posted by peers, or if they would produce their own ideas.

It is important to note that not all KidGab users chose to participate in the conformity activities, and even if a user did choose to participate, she may have chosen to participate in only a subset of the activities. We can *encourage* participation, but because of the in-

Figure 6.1: Codebook entry for the attribute 'merlons.'

the-wild nature of KidGab, we cannot enforce mandatory participation.

6.2.3 Data Preprocessing

Following 275 days of data collection (351 sketches by 53 users), we began our analyses. A single coder (the first author) began by coding each sketch's critical attributes (i.e. 'door handle,' 'face,' 'merlons,' 'rainbow,' 'sun,' 'sunglasses,' 'turrets,' 'windows,' and 'wooden door' for the top-left sketch in Figure 6.1). This coding took place on an admin-only page of KidGab, and attributes were stored in KidGab's database for easy

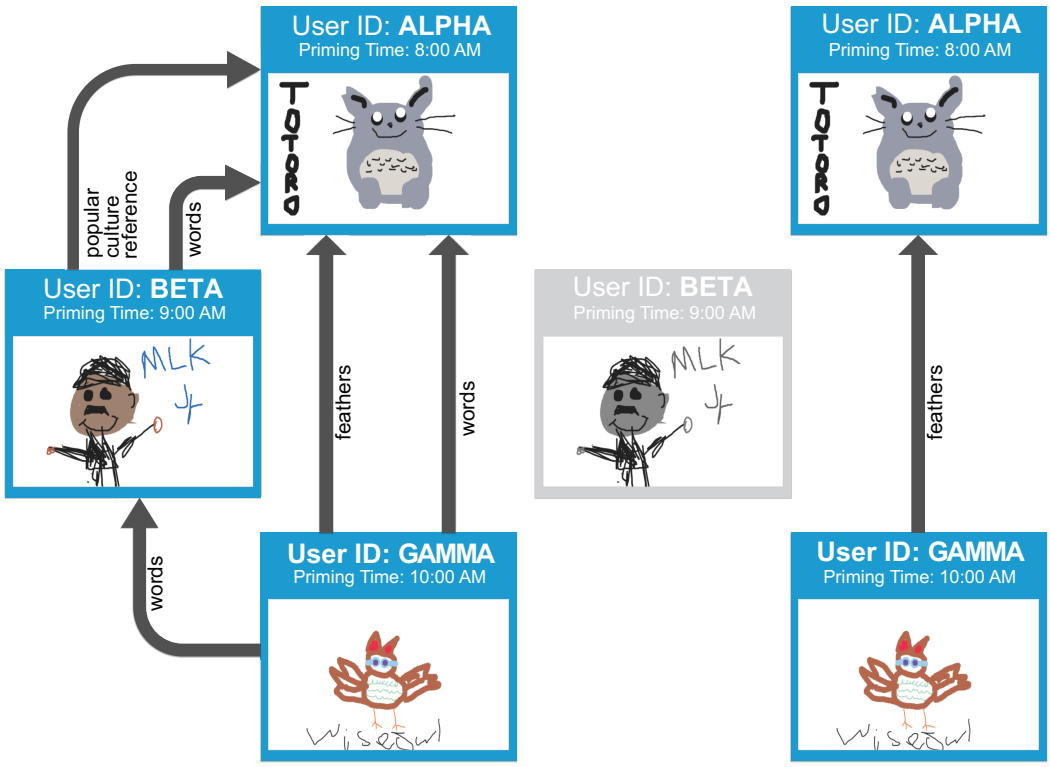


Figure 6.2: Example graphs with sketches as nodes and attributes as edges. Graph (a) includes nodes and edges for all attributes, while graph (b) is a subgraph of (a), which includes nodes and edges for only the attribute 'feathers.'

cross-querying. To ensure coder reliability, each attribute defined by the coder had a digital codebook entry, which provided a short description as well as all sketches previously found to include that attribute. An example codebook entry can be seen in Figure 6.1. The coder iterated through each sketch at minimum three times in order to ensure all attributes were appropriately and consistently applied, and to ensure that all corollary attributes were included (for example, all sketches with the attribute 'sapphire' should also include the attribute 'gemstone').

6.2.4 Statistical Analysis

Each datapoint in the presented analysis is a sketch by a specific KidGab user (userCount = 53 users). For each user, we gathered two types of data: social networking participation statistics and conformity statistics based on the sketches created in response to our quest prompts.

The social networking participation statistics include average daily and max daily counts of activities completed on KidGab, such as the number of logins, posts, mentions, comments, likes, avatar changes, theme (cover photo) changes, 'about me' updates, etc.

To compute the conformity statistics, we first create graph structures of our data with sketches as nodes and attributes as edges. An edge points from user BETA to user ALPHA if 1.) BETA was primed with ALPHA's sketch and 2.) ALPHA and BETA have an attribute in common. Figure 6.2(a) displays a simplified version of such a graph. For the unprimed prompts, we waive requirement 1 — an edge points from BETA to ALPHA as well as from ALPHA to BETA if the two nodes share an attribute. Because our algorithms (see below) cannot handle multiple edges between two nodes, we set the initial weight of each edge to be equal to the count of attributes user BETA shares with user ALPHA.

We generated one graph that included all attributes for all activities, as well as subgraphs which included only the attributes for specific activities. The four primary subgraphs consider the activities that are unprimed (UP), primed (AP), socially primed (SP), and non-socially primed (NSP). A cheatsheet for these acronyms can be found in Table 6.2.

Next, we apply an algorithm to the graph structure (or merely to the data, as is the case

Acronym	Description of Graph Configuration
UP	**Unprimed** — No priming images were provided to subjects.
AP	**All Primed** — Priming images were provided to subjects, both with and without identity markers (usernames).
NSP	**Non-Socially Primed** — Priming images were provided to subjects, but the images did not contain identity markers.
SP	**Socially Primed** — Priming images were provided to subjects with identity markers.

Table 6.2: Cheatsheet of graph configuration acronyms and definitions.

for algorithm 3 in the following list). In this analysis, we employ the following algorithms:

1. Hubs & Authorities (HITS) [94, 109] — The Hubs and Authorities algorithm makes the assumption that there are two types of "good" webpages: pages that contain authoritative information (authorities) and pages that direct users via links to authoritative information on other webpages (Hubs). Good Hubs point to good authorities, and good authorities are pointed to by good Hubs. In our data, where the nodes are users (not webpages) and the edges are attributes adopted by the user (not links), a Hub score reflects the amount a user conformed to other users' ideas while an authority score represents the amount of direct influence a user has on other users.
2. PageRank [149, 109] — The PageRank algorithm gives a webpage a score based on the quantity and quality of pages that link to it. The algorithm works on the

assumption that good pages will be linked to by many other pages, which are linked to by many other pages, etc. Similarly to authority scores, a PageRank score in our analysis represents the amount and quality of influence that a user has on other users. However, differently from Authority scores, PageRank scores provide the influence of a user in the *whole population*, not just among those with whom they are connected.

3. TFIDF [174] of Attributes — The mean Term Frequency/Inverse Document Frequency (TFIDF) score is the ratio of the number of times a user employs an attribute to the total number of occurrences that attribute is employed by any user. Similarly to Shah et al.'s Novelty measure, [181] TFIDF scores measure the uniqueness of an attribute. We find the mean and max TFIDF scores over all unique attributes adopted by the user in the graph configuration under consideration by the algorithm.

A simplified summary of the algorithms and the characteristics of users whom score highly in each can be found in Table 6.3

For each sketch/graph configuration/algorithm triad, we record two values: 1.) the algorithm-generated score for a graph with edges for all attributes (all-attribute graph)[1] and 2.) the maximum score for graphs including edges for each single attribute employed by that user (single-attribute graph). For example, consider the graphs in Figure 6.2. Figure 6.2(a) includes edges for all attributes, and 6.2(b) is the same graph but only includes edges

[1] If a user has more than one sketch in the particular graph configuration, we store the mean value of the sketches' algorithm results.

Algorithm	Characteristics
TFIDF	High TFIDF scores indicate high levels of **uniqueness**.
Hub	High hub scores indicate a high propensity to **conform to others' ideas**.
Authority	High Authority scores indicate a high propensity to **influence users in one's local network to conform to one's own ideas**.
PageRank	High PageRank scores indicate a high propensity to **influence users in the global network to conform to one's own ideas**.

Table 6.3: Cheatsheet of algorithms and characteristics high-scorers.

representing the feature 'feathers.' Consider user GAMMA and the algorithm PageRank. First, we compute GAMMA's PageRank score for the all-attribute graph (Figure 6.2(a)): 0.2023. Next, we compute PageRank scores for the single-attribute graphs for each of GAMMA's attributes (such as the one in 6.2(b)). GAMMA's PageRank value for the attribute 'feathers' is 0.3509 and its value for the attribute 'words' is 0.1976; we choose the max of these. Therefore, the two values saved for the user GAMMA in this example are 0.2023 for the all-attribute score, and 0.3509 for the max single-attribute score.

With all statistics computed, we employ three methods of comparison. To compare the statistical significance between two dependent means, we use one-way ANOVA tests (hereafter denoted by a). To identify significant correlations between participation and conformity behaviors, we calculate Pearson's r correlation coefficients (hereafter denoted

by r). To compare two dependent correlation coefficients for significant differences, we calculate two-tailed Steiger's z tests (hereafter denoted by z).

6.3 Results

In this section, we address results according to our three aforementioned hypotheses regarding children on social networks: 1.) priming our users prior to an idea-generation task increases conformity; 2.) identity markers increase those conformity effects; and 3.) highly influential, highly conforming, and highly unique users exhibit distinctive behaviors on social networks for children.

6.3.1 1: Does Priming Increase Conformity?

In this subsection, we compare results from unprimed activities and all primed (AP) activities (combining socially- and non-socially primed activities). The max single-attribute Hub scores for AP activities ($mean = 0.61$) were significantly higher than those for unprimed activities ($mean = 0.34$) ($a = -18.03$, $p < .001$). Similarly, we found max single-attribute authority scores to be higher in AP activities ($mean = 0.60$) than in unprimed activities ($mean = 0.34$) ($a = 20.13$, $p < .001$). The max single-attribute PageRank scores follow the same trend as the Hub and authority scores. PageRank scores were significantly higher for the AP activities ($mean = 0.45$) than for the unprimed activities ($mean = 0.33$) ($a = 8.99$, $p < .005$). Interestingly, we found mean TFIDF scores, which measure uniqueness, to be significantly lower in unprimed activities ($mean = 0.45$) than in AP activities ($mean = 0.55$) ($a = 10.69$, $p < .005$), indicating that knowing who drew

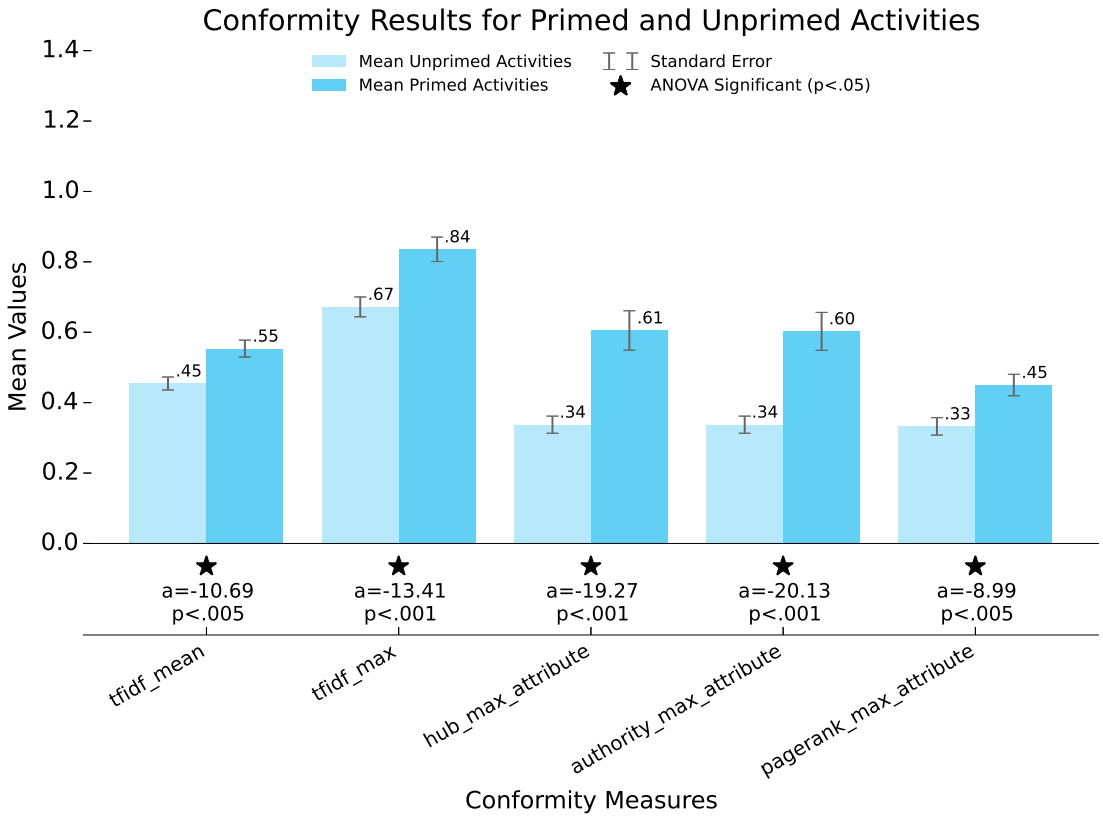


Figure 6.3: Comparison of conformity results for primed and unprimed activities.

each specific example increases the desire to be unique. For a graphical representation of these results, reference Figure 6.3.

6.3.2 2: Does It Matter Who Drew It?

Does social priming affect the conformity displayed by our preadolescent users? We found no significant difference between the means of the conformity measures with primed vs. unprimed activities (see Figure 6.4), though the results indicate that more data might provide significance. We did, however, find that there are significant differences in the *distribution* of values between the priming conditions.

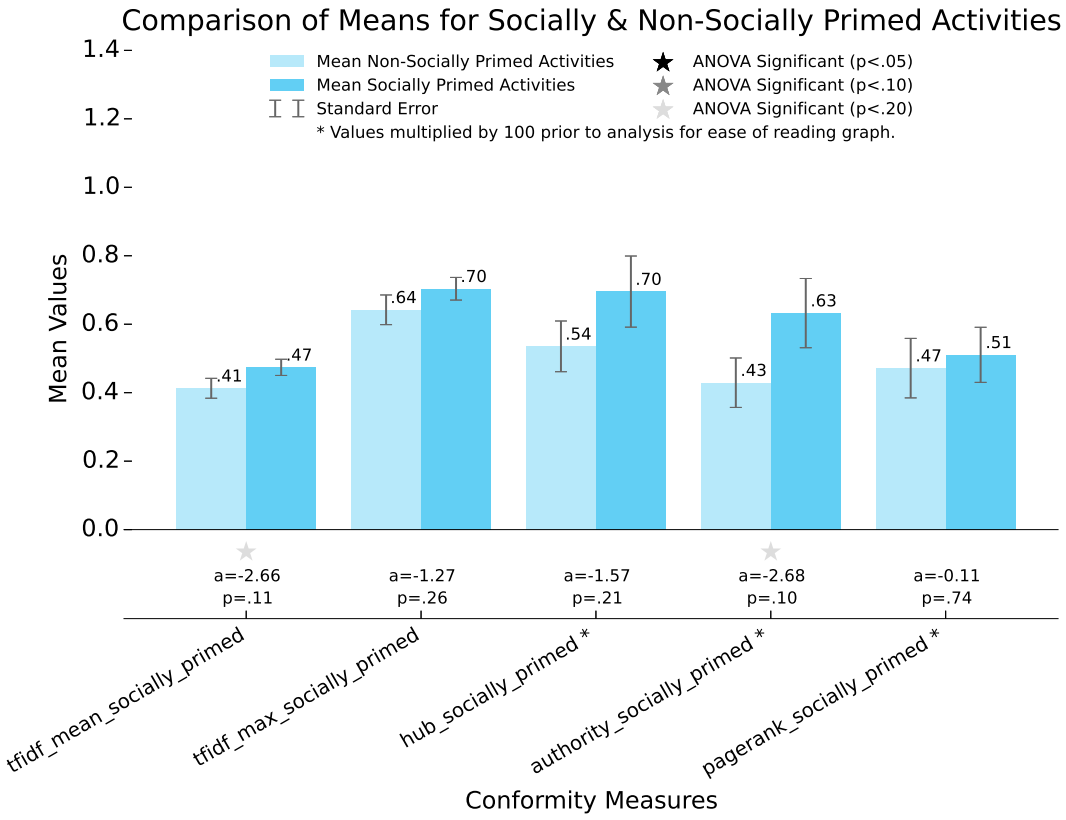


Figure 6.4: Comparisons of mean conformity results.

Consider our priming methods to exist on a spectrum, where no priming at all represents the value 0, priming without social markers represents 1, and priming with social markers represents 2. Now consider how a user's conformity scores might vary as the amount of priming increases. Take, for example, Hub scores (which measure the propensity to conform to others' ideas). As the amount of priming increases, across the general population, Hub scores remain largely the same. A linear regression provides us a nearly-zero slope, -0.001 ($r = -0.10$, $p = .24$). However, when we split the data into those who conform much and those who conform little (split according to the median of Hub scores on the AP graph), we found significant differences as the amount of priming increases. As

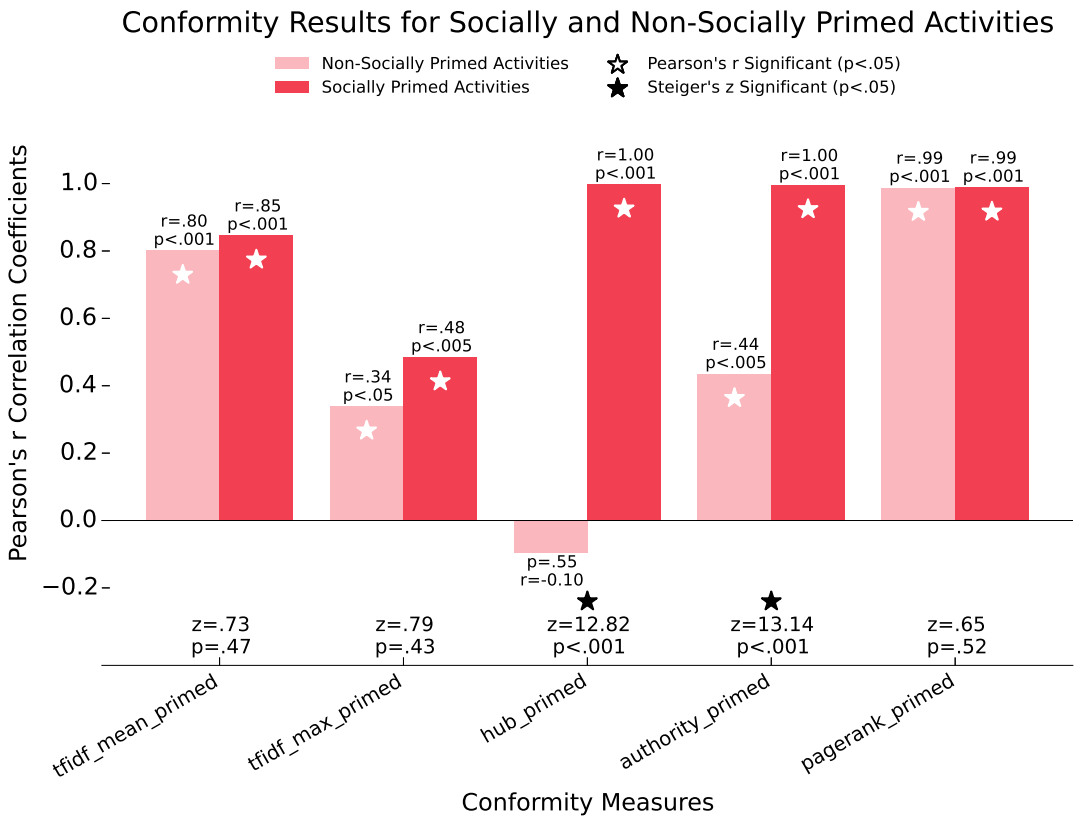


Figure 6.5: Correlations of all-primed conformity results to the results of socially- and non-socially-primed conformity results.

seen in Figure 6.6, those who tend to conform much (the top half of users), tend to conform more as they see priming images, and yet more when they see social priming images (linear regression $slope = 0.002$) ($r = 0.37$, $p < .001$). Those who tend not to conform (the bottom half of users) exhibit the opposite behavior: as the amount of priming increases, non-conformers tend to conform less and less (linear regression $slope = -0.004$) ($r = 0.37$, $p < .001$). The difference between the behaviors of the conformers and non-conformers is significant ($z = 4.464$, 0.000).

Similar behavior is exhibited by Authority scores, seen in Figure 6.7

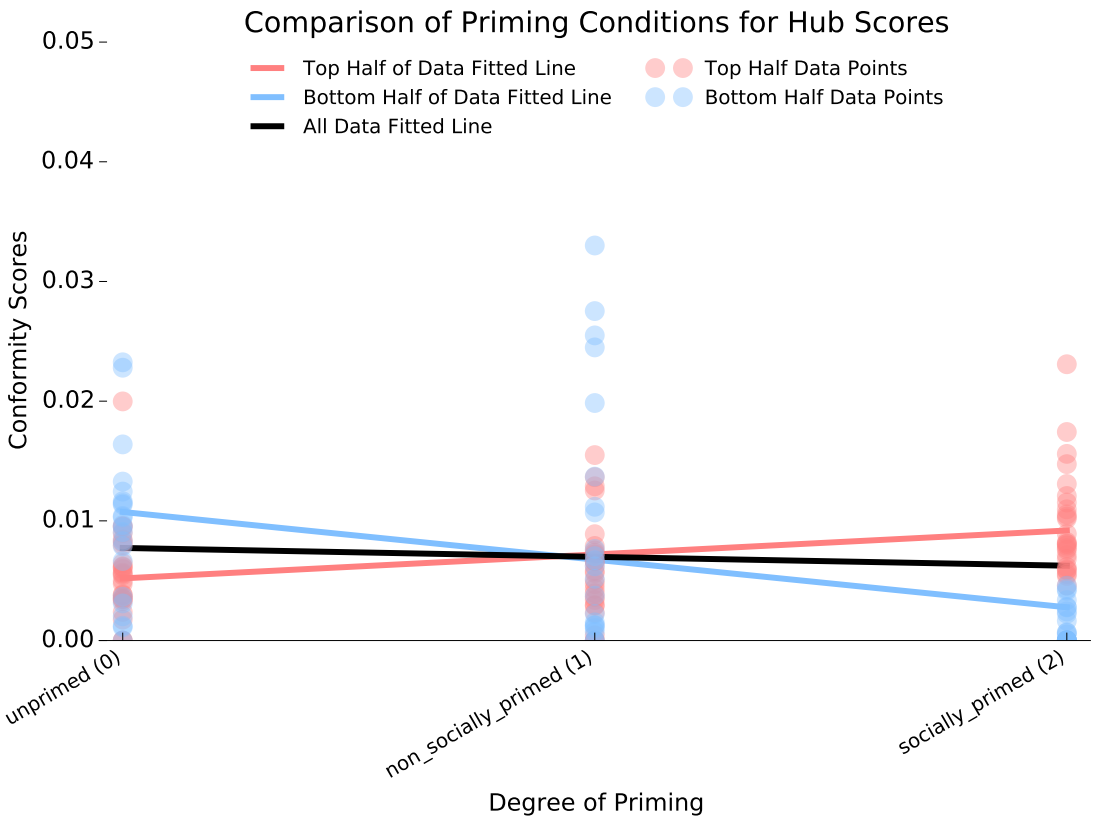


Figure 6.6: Linear regression of Hub scores as the amount of priming increases.

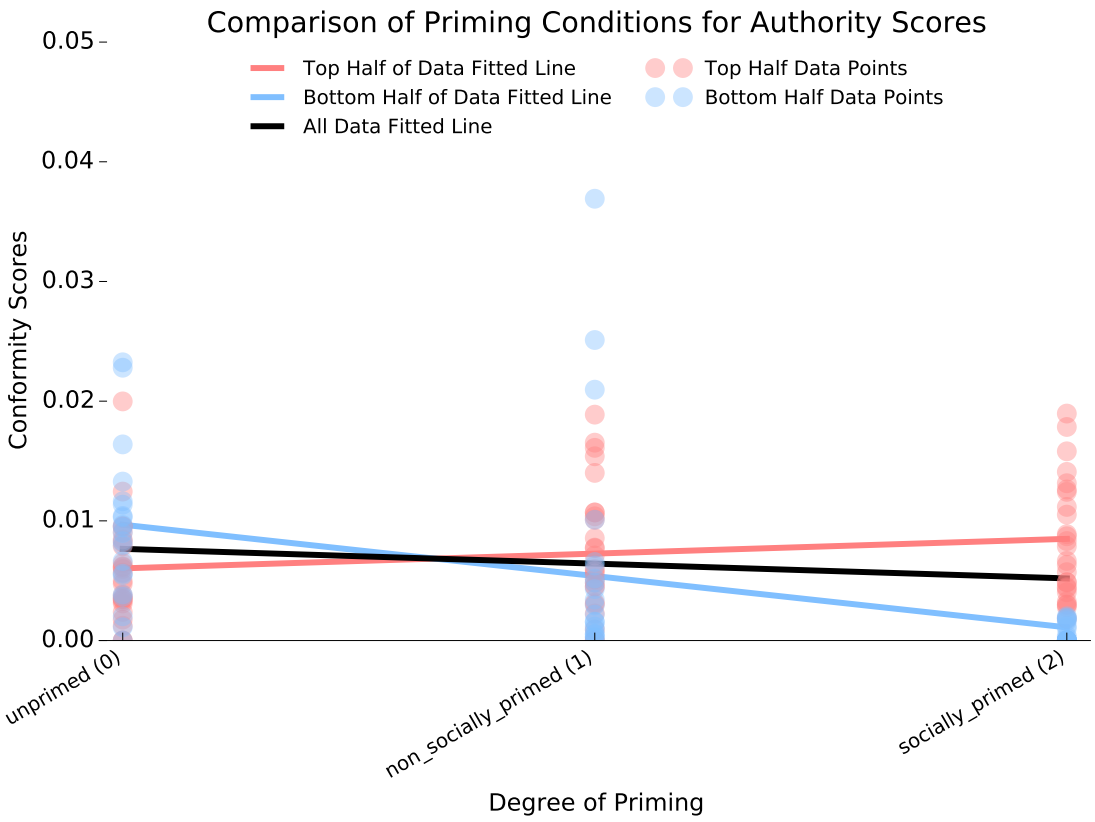


Figure 6.7: Linear regression of Authority scores as the amount of priming increases.

6.3.3 3. Do Conformity Scores Correlate With Participation Measures?

Thus far, we have discussed five conformity measures, each of which communicates a slightly different facet of conformity: TFIDF scores denote uniqueness of ideas (either one quite unique idea or overall uniqueness of a sketch), Hub scores denote a tendency to adopt either common or copied ideas, authority scores communicate the direct influence a user has over others, while PageRank scores denote the general importance and influence a user has throughout the network. A user with a high score for one conformity measure does not necessarily have a high score in other. For example, those with very unique ideas (high mean TFIDF scores) will likely not have high Authority scores. In fact, the two conformity measures do not correlate significantly at all ($r = 0.10$, $p = .51$). Therefore, users with high scores in one conformity measure are apt to behave differently on an online social network than users with high scores in other measures. Participatory behaviors that significantly correlate with each of our conformity measures (on the socially primed graph) are shown in Figure 6.8.

Figure 6.8 shows that as mean TFIDF scores (overall uniqueness) increase, the number of badges earned in a day also significantly increases ($r = 0.57$, $p < .05$). As the max TFIDF score (the uniqueness of a user's most unique idea) increases, the max number of comments received, the max number of days since a quiz release decreases ($r = -0.32$, $p < .05$), indicating that users with high uniqueness log in mostly around the time that a quiz is released. Highly unique users are highly motivated to participate by new personality quizzes.

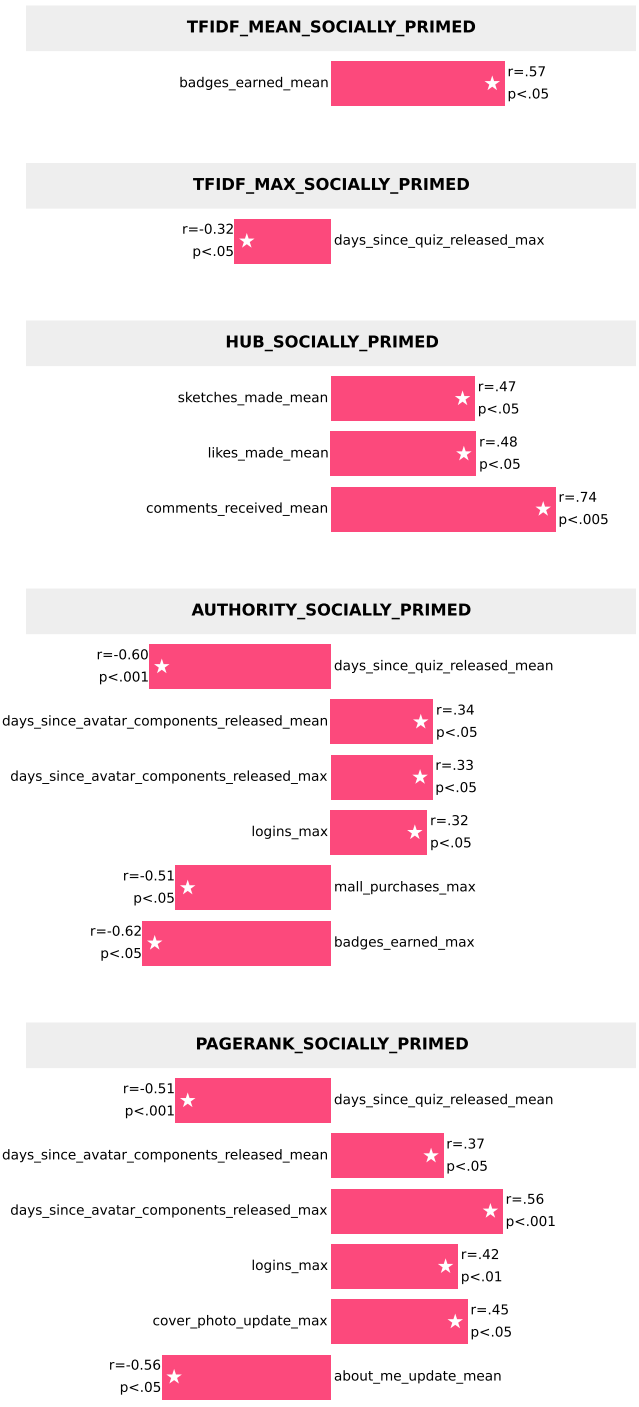


Figure 6.8: Statistically significant correlations between our conformity measures and participation features.

Users with high Hub scores (high aptness to adopt others' ideas) are very active on KidGab. As Hub scores increase, the behaviors that likewise increase are: the mean count of sketches made ($r = 0.47$, $p < .05$), the mean count of comments received ($r = 0.74$, $p < .005$), and finally, the mean count of likes made ($r = 0.48$, $p < .05$).

Similar to high mean TFIDF scores, high Authority scores (measuring high local influence) correlate negatively with the number of days since a quiz release, indicating a high motivation to take new quizzes among highly influential users. This enthusiasm for new quizzes does not transfer to the release of new avatar components, however — both the mean ($r = 0.34$, $p < .05$) and max ($r = 0.33$, $p < .05$) number of days since an avatar component release are positively correlated with Authority scores. Additionally, high Authority scores correlated negatively with the count of mall purchases ($r = -0.51$, $p < .05$), again indicating a lessened interest in avatar-related activities. High Authority scores correlate positively with high counts of logins per day ($r = 0.32$, $p < .05$), but correlates negatively with badge-earning behaviors ($r = -0.62$, $p < .05$).

Finally, high PageRank scores (measuring the influence a user has over the whole network) follow the example of Authority scores in that they correlate negatively with days since a quiz release ($r = -0.51$, $p < .001$), and positively with both mean ($r = 0.37$, $p < .05$) and max ($r = 0.56$, $p < .001$) days since an avatar component release. Like users with high Authority scores, users with high PageRank scores are highly motivated by quizzes but not by avatar-building. Users with high PageRank scores participate in daily bursts, with many logins ($r = 0.42$, $p < .01$) and cover photo updates ($r = 0.45$, $p < .05$)

per day. Users with high PageRank scores also routinely update the About Me sections of their profiles ($r = -0.56$, $p < .05$).

6.4 Discussion

As found and confirmed in many studies [188, 107, 187] with adult participants, but prior to this work uninvestigated among children, priming participants with examples before a creative exercise increases conformity. The significant differences between between unprimed and all-primed activities among mean TFIDF scores indicate that the max and mean uniqueness of attributes increases with priming, meaning that exposure to others' ideas increases the uniqueness of one's own. However, the propensity to copy others' ideas and to have one's ideas copied increases with yet greater significance when primed with previously-submitted ideas. In short, both uniqueness and peer influence increase when children can see the way others responded to the same creative ideation task.

The lack of significant differences between NSP and SP prompts among any of our conformity measures indicates that on a general level, social priming makes little to no difference in the amount of uniqueness, conformity, or influence expressed in our creative ideation tasks. Among those children who are highly conforming or influential, however, the sociality of understanding who contributed which ideas intensifies those characteristics. Interestingly, social priming had the opposite effect on low-conforming and low-influential users — understanding who contributed which ideas decreased both conformity and influence. This confirms the idea that children conform to perceptible norms in order to fit in

[191], but they also strive to demonstrate (socially acceptable) unique characteristics to differentiate themselves from the group [18].

We found many behaviors associated with highly unique, highly conforming, and highly influential users. Those who contributed very unique ideas (high TFIDF scores) tended to earn many badges and be motivated to participate by new quiz releases. Though unique-idea-generating children are a little-studied population, our lack of results connecting high amounts of peer attention with high uniqueness seems to contradict the idea that trendsetters are those who tend to get a great deal of (both positive and negative) attention from peers [20].

Those children who displayed highly conforming behavior (high Hub scores) tended to chose socially forward and highly visible activities such as liking and sketching. This behavior is rewarded with many comments from other users. This is in line with Brechwald et al.'s assertion that highly conforming users also tend to be highly visible [20]. Highly conforming children tended not to start many new conversations (no significance with posting or mentioning behavior), rather they preferred to post independent and expressive posts and show approval of others' expressions. This is in line with Snyder et al.'s finding that children tend to engage in already-established behavior in an attempt to gain acceptance and approval [191].

Highly influential users tended to be highly motivated by new quiz releases but not by avatar-building activities. Many brief login sessions are the norm for highly influential users, whom also frequently update the visual aspects of their profile pages (namely cover

photos) while neglecting the textual aspects (namely 'about me' updates). Surprisingly, we did not find any support for the findings in prior research that children tend to mimic the behaviors of the high-status peers [36, 83] (synonymous with our highly influential peers). Perhaps more data will help us to understand more about the participatory behaviors of highly unique, conforming, and influential children on online social networks for children.

6.5 Conclusions & Contributions

Though our quest prompts existed in a controlled corner of our social network, we believe our conformity results are largely transferable to general social networking behavior. Our results generally correspond to works outlining peer influence and conformity in the literature. To this, we add more specific behavioral information regarding the daily goings-on of a child participating on a social network. The contributions of this work are rich:

- First, we found that priming children with examples significantly increases conformity in creative ideation tasks.
- We also found that priming with identity markers significantly increases the degree of conformity for those who tend to conform (but makes little difference for those who do not).
- We found that highly unique, highly conforming, and highly influential users exhibit significant and defining behaviors.
  - Highly unique users tend to choose expressive activities such as badge-earning;

- highly conforming users tend to choose socially forward activities, such as sketching and liking;
- and finally, highly influential users tend to be highly motivated by new quiz releases, but tend not to be motivated by avatar component releases.

In future work, we hope to explore more measures of conformity in order to understand conforming behaviors in greater granularity. Particularly, we are interested in Kerne et al.'s measure of emergence [87]. We could measure emergence using k-grams of features, rather than individual features as edges in our graphs.

7 AFFORDANCES THAT PROMOTE ENGAGEMENT AND IDENTITY EXPLORATION ON SOCIAL NETWORKING SITES FOR CHILDREN[1]

Today's youth are online. In fact, to many youth, their identities are not proven to exist without an online presence in the form of an online social networking profile or blog [195]. Many researchers in the last decade have attempted to understand how teens act and behave online, what interests them, and what they like and dislike [18, 17, 42, 60, 68, 77, 216, 144]. Boyd, for example, conducted a two-year ethnographic study on teens and their motivations and behaviors on social networks [18]. Boyd found that connectivity to musicians and celebrities, public connectivity to acquaintances and friends, and finding a balance between uniqueness and conformity in public identities motivated users to participate on Myspace. Clarke [34, p22] posited that social networking sites provide "young adolescents a sense of agency and encourages them to take responsibility for shaping their own development." Itō [77] suggested that online social networking for teens encourages a sense of solidarity and a space for teens to get recommendations from peers about what television shows to watch, what music is worth listening to, what to wear, what to like, etc. This sampling of researchers' conclusions about youth social network users all echo a common theme — that social networks provide youth a space to

[1]This chapter was originally published under a creative commons license as "An Analysis of Participation, Identity Conversations, and Social Networking Affordances on an Online Social Network for Children" by Stephanie Valentine and Tracy Hammond, 2016, *Journal of Media Innovations*, Volume 3, Issue 1, Pages 41-62, Copyright 2106 by Stephanie Valentine & Tracy Hammond.

explore their identities.

This collection of work is vast and compelling but has several limitations. First, most studies regarding motivations and behavior of online youth typically consider a teenage population; there is very little published research regarding how and why preadolescent children (ages 7 to 12 years) participate on online social networks. Secondly, each of the above-mentioned studies describes social networking behaviors from the self-reported perspective of the youth social networker herself. Bauman and Tatum define social networking as the co-creation of interactive communications, by the users and by the platform [12]. In the above works, there is a valuable perspective missing from the analyses: the perspective of the social networking platform. The platform contains the complete record of actions and communications made by a user every nanosecond of every day. Only a few researchers have designed social networks for children [1, 81, 143, 214] and even fewer have actually developed and deployed such a system to understand how children actually interact with it [76, 217].

To address this chasm in published knowledge regarding the actual behaviors of preadolescent children online, we designed, developed, and deployed a social network of our own: KidGab. KidGab is a private social network for preadolescents to learn expressive and safe social networking habits before they reach the age of 13 years, the age at which one can legally join most adult social networks. In this work, we analyze the self-presentation and identity-related behaviors recorded on KidGab, specifically in reference to the common affordances of personality quizzes and rewarded topic-based posting

(our badge system). Youth say they are motivated to maintain online profiles because it is a means of self-reflection [18], yet they simultaneously crave meaningful feedback from their peers (Stern, 2008). Does the artificial feedback acquired from personality quiz results overpower the desire for self-reflection? Previous work examines and relays youth social networking users' overall objectives, but this work explains what youth actually do on online social networks.

7.1 Background

This study focuses around two major concepts and their relationships with youth and digital media: identity and self-presentation. In this section, we explore the foundational works upon which we have based the definitions and methodologies presented in this work. Identity is an overloaded term, defined differently by researchers of various fields, especially in the context of youth and adolescents. Is identity a thing or a process [13]? Are youth merely "becomings" — compilations of adult influences — or are they "beings" in their own right [24]? Buckingham's [24] "Introducing Identity" provides an extensive review of a myriad of perspectives on definitions identity with respect to youth and digital media. For the purposes of this study, we define identity according to Larson's [110] view: one's identity is "a personal iconography of values, symbols, and identifications that answer the question, 'Who am I?"'. To this, we add an experiential component. One youth blogger interviewed by Stern [195] mused that her blog (her online identity) is a chronicle of who she is, what she has experienced, and how she feels about it. In the same work, Stern

presents an argument that the analysis of online cultural production should be done from the vantage point of the youth, rather than from the adult standards of evaluation which may be inappropriate for youth subjects. As such, we consider this view of youth digital identity, astutely provided by a member of the digital youth population, as an appropriate addition to Larson's "analog" definition of identity.

The second concept paramount to this work is that of self-presentation. Classically, self-presentation is defined as a process through which a person constructs every external interaction, each utterance and action, into a carefully constructed presentation for an audience, usually with the intention of eliciting approval [58]. This view of self-presentation brings about two corollary concepts crucial to the discussion of digital identity and youth. Firstly, in the context of digital participation, we must consider that every digital artifact is made with an audience in mind (be it the self, close friends, or the world) [18, 195]. Second, we must remember that the predominant motivation of such utterances and actions is to elicit the approval of others [195]. Buckingham united the concepts of self-presentation and identity among digital youth with a simple statement, "Identity is developed by the individual, but it has to be recognized and confirmed by others" [24, p5].

Youth have described their self-presentations on social media as attempts at appearing cool (as defined by the target audience's perception of cool), introspective, witty, or alternative (specifically in respect to musical tastes) to the audiences they target [18]. Over time, as youth develop this chronicle of audience-targeted self-presentations, youth effectively "write themselves into being" [4, p129]. This being, authored by an individual for

an audience, ultimately seeks acceptance from that audience. Indeed, social approval in the form of positive feedback is the primary motivator for using digital media as a "chronicle" of one's identity [195]. During adolescence, youth begin to increase their concern for conformity, fitting in, and not feeling alone. In this time, the desire for feedback (in the form of site visits, likes, guest books, comments, etc.) from members of their actual or desired peer group is intense [195]. Such feedback reassures the youth that they are valued and that they are not alone.

Modern social networks for youth share many common affordances: avatars, "about me" areas, textual posting, comments, friends lists, topic-based posting (sometimes motivated by digital badges), and personality quizzes. How is each of these theoretically motivated? Photographic or cartoon avatars allow youth to strategically refine others' perceptions of their body and the role they intend to play in society [201]. Textual posting and "about me" sections provide vehicles through which youth can directly author and revise their self-presentations [4, 18] by chronicling their feelings and experiences. Comments form the foundation of social discussion and provide youth the feedback they so acutely desire [195]. Friends' lists play the vital role of concretely depicting one's peer group. Some of the most important self-presentations on a youth's digital media page are the connections with others because they believe in some respects "they are who they know" [18]. Friends lists provide evidence of the social categories they fit into, and each connection can be seen as a sort of endorsement [42, 77], thus catering to youth's desire for approval and feedback. Youth interactions with each of these features of modern digital media have

been studied in detail via qualitative methods (particularly via ethnographic methods).

The two social networking affordances discussed in this work are much less-studied: topic-based posting (as motivated by a digital badge system) and personality quizzes. Topic-based posting, informally described as participating in popular digital cultural movements (e.g. posting opinions regarding popular political/media topics using a predefined hashtag) appeal to youth's desire to use social media as a tool of self-reflection [24, 195]. By writing out feelings, one grows to better understand how he or she feels [195]. Occasionally such topic-based posting behaviors, are rewarded via digital badges [5], which can in turn be used to represent a user's clout in the digital community [63]. This practice of topic-based posting involves some risk, however, because adding original thoughts to a movement of pre-existing opinions and experiences allows for disagreement and unrelatableness — two effects contrary to the goals of acceptance and conformity carried by youth [195]. Youth seek feedback from people who can relate to them, feedback that validates their opinions and identities [18]. Such feedback is not likely to appear when the youth's peers cannot relate to the ideas expressed in the post.

Personality quizzes allow youth to explore their own identities and receive concrete descriptions of their personalities (for them to agree with or disagree with in turn) [18]. This concrete description, in the context of a community whose members have likewise taken the quiz, allows youth to see clearly how they are the same as others and how they are different. Personality quizzes offer three advantages and allures. Firstly, they could be considered an artificial but very concrete form of the positive and individualized peer

feedback that youth so intensely crave. Secondly, self-presentation in the form of personality quiz results generally lacks the social risks of disapproval and unrelatableness seen in self-authored digital artifacts (such as those for topic-based postings); the responsibility for authorship of the personality description is offloaded to the author of the quiz. As such, personality quiz results could be seen as a less risky starting point for discussions and self-presentations. Third, the acts of taking a quiz and posting quiz results provide youth a shared experience to discuss. Shared experiences serve as the foundation for conversation in both online and offline situations [32, 48].

In this chapter, we investigate the motivations of topic-based badge systems and personality quizzes and their relationships to overall online participation on social networks for youth. We define online participation as the quantitatively measurable collection of activities recorded by an online social networking platform, such as logins, posts, comments, likes, taking quizzes, and earning badges.

7.2 This Work

This work is unique in many ways. We conduct our analyses on data collected from our own, custom-designed social network for children, KidGab. We have access to every activity completed by the users: complete user profiles, extended metadata, and a clear understanding of the activities occurring across the entire network at all times. Additionally advantageous, we have the ability to manipulate circumstances in order to understand the impacts of specific events on participation. For example, we have full control over

the release times for personality quizzes, which allows us to study the effects of timing on participation. Secondly, as mentioned above, very little research in social networking investigates online behavior of children due to the legal complications involved with data collection and parental consent. Because we manage the network ourselves, we are able to obtain appropriate consent and assent both to participate in research and to collect online data about our child users. Only children who themselves assent to participate and whose parents likewise consent to their participation are allowed access to our social network. Provided the wealth of data including user reactions to stimuli we introduce on the network, we chose to study and understand which of our affordances (badges or quizzes) actually resulted in more community participation. Specifically, we study whether badge systems or personality quizzes garner more prevalent activity and whether these stimuli correlate with an increase in conversation about identity.

7.3 Research Questions and Hypotheses

In this study, we seek to answer several questions comparing badge-earning and quiz-taking behaviors. Do youth choose to engage with one affordance more frequently than the other? Does engaging with one affordance increase overall site participation more than the other? Which induces more discussion of identity? Which desire is stronger; the desire for feedback (quizzes) or the desire for self-reflection (badges)? To answer these questions, we test four hypotheses:

1. There exists a significant positive correlation between online participation and the

taking and posting of personality quizzes among preadolescent girls.

Rationale: Personality quizzes are a low-risk and shared-experience starting point for communication and engagement with (as well as relating to and learning about) other members of an online community. "You got Gryffindor? I got Ravenclaw!" Such simple interactions forge the pathway to more interactions, and, as a result, participation grows.

2. There exists a significant yet weaker positive correlation between badges and online participation of preadolescent girls.

   Rationale: Sharing opinions and experiences surrounding predefined topics is an attractive activity for self-reflection, but the risks of disapproval and unrelatable-ness for both the author and potential commenter make it less likely to spur more participation than personality quizzes.

3. Personality quizzes encourage online discussions of identity among preadolescent girls on social networks.

   Rationale: Given Hypothesis 1, it follows that the riskiest discussions — those that have the potential to elicit identity-threatening disapproval from peers — might be best started in relatively safe places.

4. Badges also encourage online discussion of identity among preadolescent girls but to a lesser degree than do personality quizzes.

   Rationale: The social risk associated with agreeing or disagreeing with a person makes it less likely to be a starting-point for discussion, especially when the discus-

sion regards a sensitive topic like one's identity.

7.4 Method

7.4.1 KidGab

We test each of these hypotheses using data collected on KidGab. To summarize Chapter 4, KidGab is a custom social network for children aged 7 to 12 years. We designed and built KidGab as a means of studying social networking behaviors of children from the inside out. KidGab features most basic social networking affordances, including unrestricted textual posting, unrestricted textual commenting, image upload, "like" functions, groups, chat rooms, etc. Figure 7.1 displays a sample profile page on KidGab. We specifically designed KidGab to include few restrictions, rather to enable children the freedom to express themselves and learn safe social networking habits through mentored and monitored practice. Parents and researchers frequent the network to ensure users are behaving safely and respectfully. In the case a researcher or parent finds a post or behavior to be unsafe or disrespectful, he or she can address the situation with the relevant users in a calm and educational manner. KidGab is intended for use in small communities of children (schools, sports teams, scouting troops, youth groups, etc.) as a medium through which to practice digitizing existing friendships and to keep organizations connected.

Beyond avatars, another social networking affordance for self-expression offered by KidGab is sketch-based posting. Users can sketch images using KidGab's sketch interface and post their artistic masterpieces to their own or their friends' walls. Figure 7.1 includes

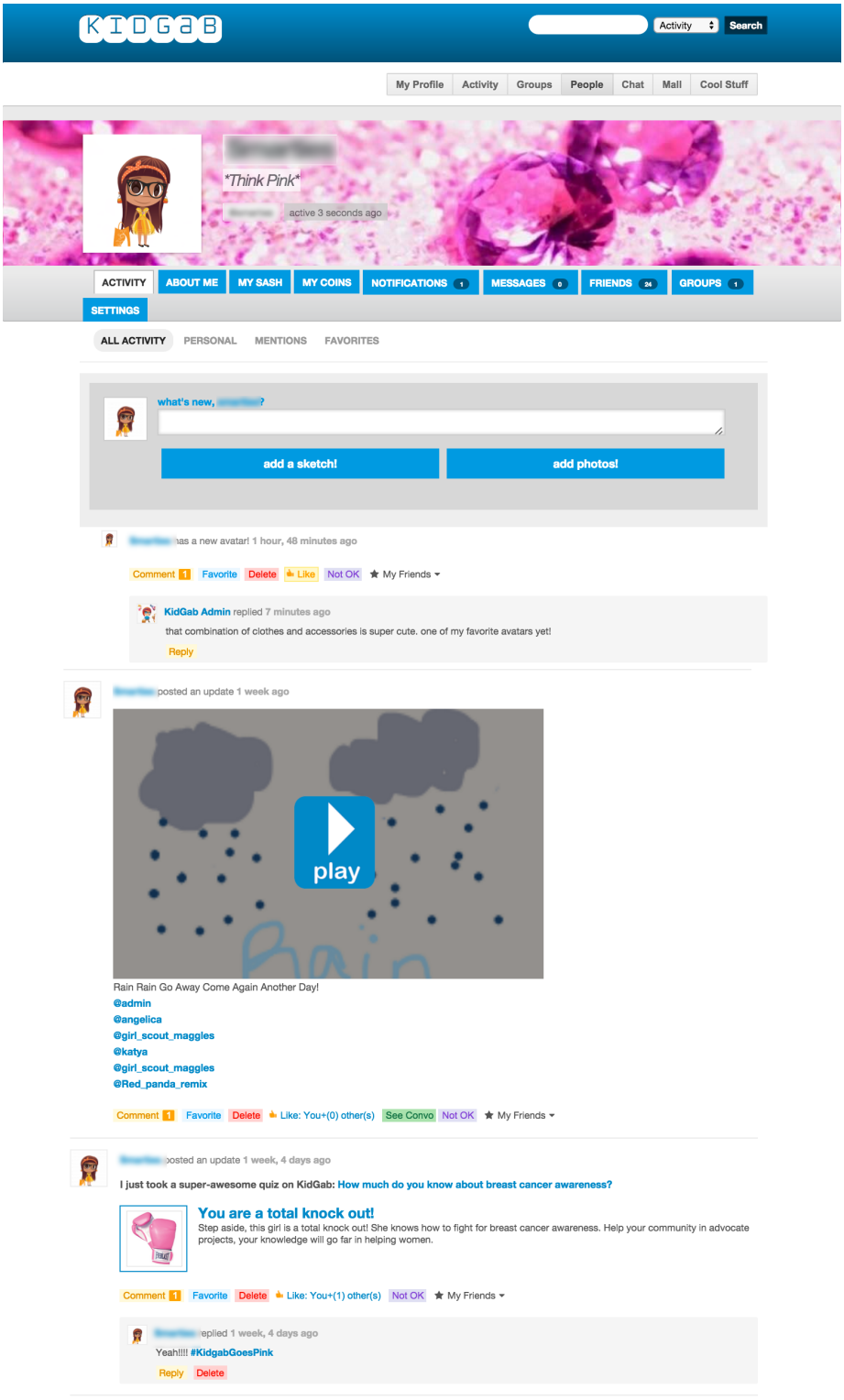


Figure 7.1: Example of a user's profile page. Usernames blurred to maintain the user's privacy.

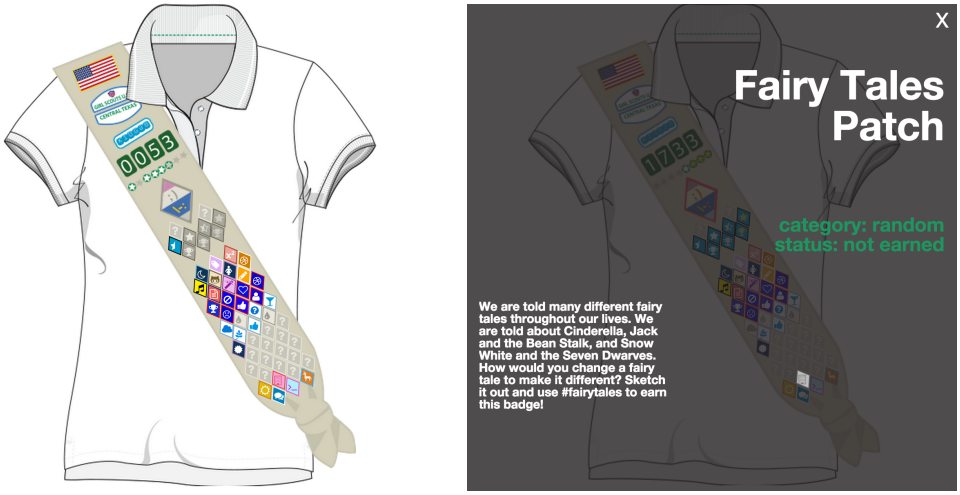


Figure 7.2: Complete view of the Digital Sash and the Digital Sash in explore mode.

a sketch of rainclouds posted by one of KidGab's users. As hinted by the triangular "play" button atop the sketch, KidGab's sketches are not stored as mere images; rather they are stored as short videos that replay the sketch composition from start to finish. This sketch playback allows for multi-scene storytelling and simple animations.

Most important to this study are the social networking affordances for gamified topic-based posting and for the taking of personality quizzes. Our topic-based posting system is called the Digital Sash [206]. The Digital Sash provides simple sketch- or writing-based tasks for users to complete. Upon completion of the tasks, users earn a digital badge. Our rewards system takes the form of a Girl Scout sash because the audience for our initial deployment is a local Girl Scout council (more deployment details follow in the next section). The artwork for such an online reward system could take many specialized forms, but the underlying system that makes suggestions for post topics and rewards users for completing the tasks as described is universal. Figure 7.2 displays screenshots of how a user might ex-

plore the badges available to be earned and the instructions for earning them. Badges that are in color have been earned and badges in grayscale are yet to be earned. The example in Figure 2 displays the Fairy Tales badge. The instructions for this badge encourage users to add a new twist to an old fairy tale. To earn the badge, users should illustrate their twists with a sketch and use #fairytales (the hashtags allow the system to automatically award badges). The user whose digital sash is shown in Figure 2 (we will call her Mackenzie) earned the Fairy Tale badge with the post shown in Figure 3. Mackenzie sketched Snow White refusing the poisoned apple offered by the evil queen and annotated Snow White with the words, "LOL, Nope." Over a period of 4 weeks following a user's registration on KidGab, KidGab releases approximately 45 badges (one or two badges per day) that can be earned through the procedures described above.

The second of the social networking affordances especially relevant to this study is a continually-increasing collection of whimsical personality quizzes authored for the purpose of entertainment (not for purposes of scientific personality analysis). These quizzes are simple radio-button web forms with themes like "Which team sport should you play?", "Which Harry Potter pet should you bring to Hogwarts?", "What new look should you try on your hair?", or "Which Pokémon are you?". Based on the choices in the quiz, users receive different results. For example, the selections chosen in the "Which Harry Potter pet should you bring to Hogwarts?" quiz, shown in Figure 4, led to the result "Owl." A user can choose to post her results to her wall using the blue button beneath her results. Posted quiz results appear on the user's wall in the style shown in Figure 4. At the time of

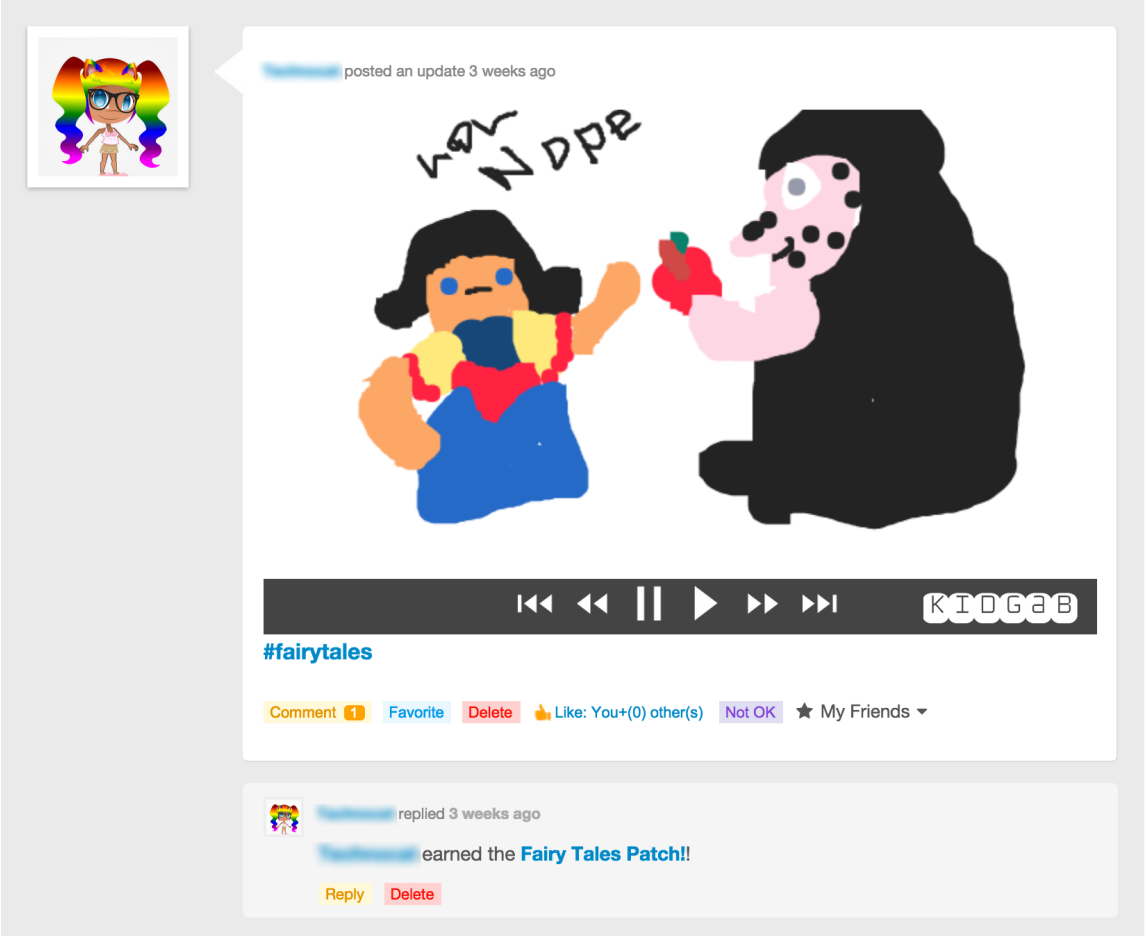


Figure 7.3: Mackenzie's response to the Fairy Tales badge described in Figure 7.2.

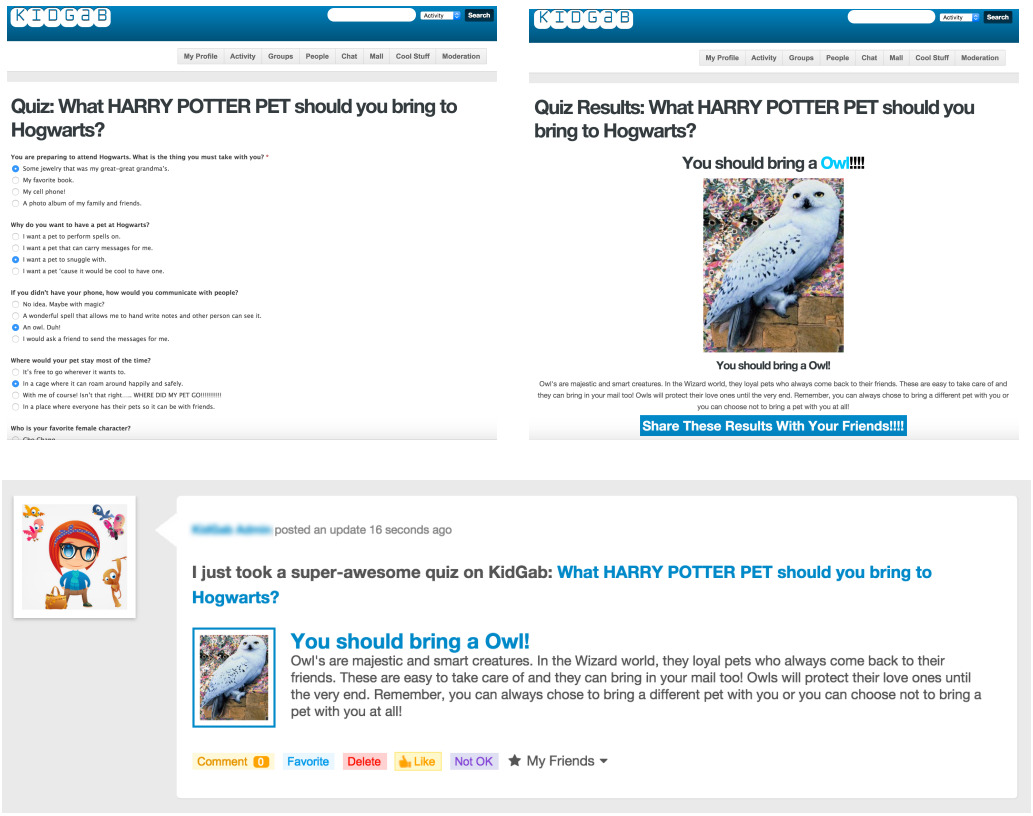


Figure 7.4: Screenshots of a quiz, quiz results, and a quiz post.

the data analysis described here, 31 quizzes were available for users to take and explore. We attempt to author and release at least one new quiz per week.

7.4.2 Data Collection

In keeping with the larger goals and research objectives of the KidGab project (not specifically addressed in this paper), all girls that join KidGab first partake in a 4-hour workshop led by our research team. The workshops teach skills for safe and healthy digital friendships to groups of 5 to 25 girls aged 7 to 12 years. The workshop curriculum includes a hands-on, guided tour of KidGab (users almost always have not participated on the site prior to the workshop). Following the workshops, we encourage the Girl Scouts to use

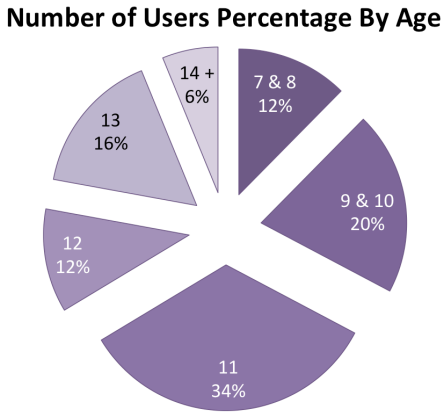


Figure 7.5: Age distribution of our participants.

KidGab as a tool to grow and improve the friendships they kindled with other girls at the workshops.

In March 2015, we deployed KidGab to the first cohort of Girl Scouts. In the seven months between the first deployment and the time we conducted the analysis presented here, we engaged 13 other cohorts for a total of 214 Girl Scout users. Beginning in June 2015, upon approval from our institutional review board, we opened registration to any Girl Scout who provided an active Girl Scout membership number and provided online signatures for consent/assent. The age distribution of all of our participants can be seen in Figure 5. Occasionally, girls up to age 16 opted to participate in the workshops, but were rarely active on KidGab thereafter.

Following the workshops, we encouraged online participation on KidGab through emailed notifications of both badge releases and quiz releases. Our results show that approximately 37% of the participants logged in to KidGab following the workshop. We call the users that return to KidGab following the workshops returning users. In this analysis,

we study the behavior of only these returning users (80 users), because the data collected from the in-workshop activities of the non-returning users4 could skew our results by including potentially misleading activity quantities on workshop days.

Each datapoint in our analysis represents a single day of deployment on KidGab. For each day, we count activities and artifacts that occurred on that day. The days range from 1 to 228. Day 1 translates to March 8, 2015. Figure 6, which shows the number of unique users that logged in to KidGab on each of the 228 days of the study, provides a snapshot of the distribution of activity experienced throughout the study. To eliminate outliers with the potential to skew our analysis, we removed all days with zero activity (66 days) and days with excessive surges of activity (1 day). On twelve days, we deployed KidGab to new users in our workshops and suspected that the increased activity might skew our results. However, we found no significant differences between our results sans workshop days and our results including them. Therefore, we included workshop days in our analysis. In the 161 days included in our analysis, our returning users logged in 1023 times and authored 1418 posts, 309 comments, and 1044 likes.

Though each girl and the activities she completes per day are by nature unique, an average daily session per user[2] includes approximately 1.99 logins, 2.43 posts, 0.55 comments, 1.51 quizzes taken, and 0.82 badges attempted. These values, their standard de-

[2]Daily-session averages were calculated using the following formula:

$$\frac{\sum_1^S \text{activity count of user in day session}}{\text{number of day sessions, S=518}}$$

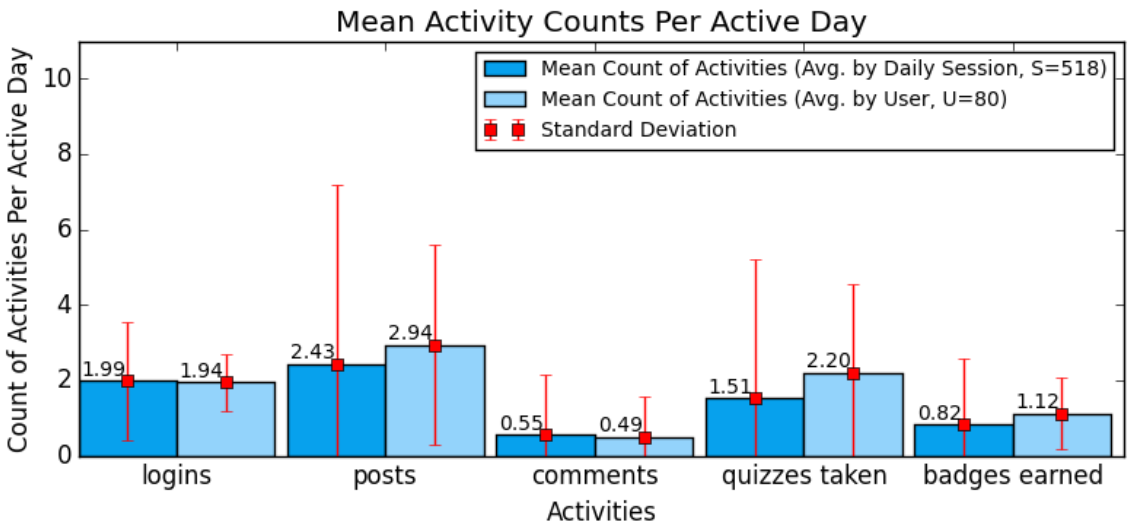


Figure 7.6: Usage statistics representing the average activities completed by a user on an active day.

viations, and similar values averaged by user[3] (instead of by user-session) can be seen in Figure 7. To ensure a few users do not significantly skew our results, as may be suspected based on previous research indicating power-law distributions of user activity online [22, 101], we duplicated all of our analyses on a dataset excluding our most-active 10% of users. The results of these analyses revealed no differences in conclusions, save one minor statistic noted in the Results section below. All 80 users were therefore included in the presented analysis.

We record nearly every activity a user completes on KidGab, including time and date as well as other relevant metadata for every action, such as successful login, failed login, password change, post authored, comment authored, activity liked, activity deleted, avatar

[3]User-based averages were calculated using the following formula:

$$\frac{\sum_{1}^{U} \frac{\text{total activity count of user}}{\text{number of day sessions of user}}}{\text{number of users, U=80}}$$

changed, theme changed, profile updated, quiz taken, and badge earned. We used relevant subsets of this usage data to conduct the analysis discussed here.

7.4.3 Data Preprocessing: Coding and Labeling

Because two of our hypotheses center around the concept of identity-related self-presentations on KidGab, we utilized methods of qualitative data coding to identify posts and comments that reference identity. The qualitative codes (identity themes) allow us to analyze what exactly youth are discussing regarding identity, and specifically which themes of self-presentations follow quizzes and badges. All coding procedures were conducted by a single researcher (the first author), whom we will call the coder.

In the first, open-coding stage of preprocessing, the coder read through all posts and comments made by girls on KidGab (parent, researcher, and troop leader messages were not included), making note of the words and expressions used to talk about identity, according to the definition of identity described above. The coder took note of words, expressions, and sketched depictions that described a user's values, symbols, identifications, or experiences that answer the question, "Who am I?" [110, 195]. Examples of codes identified in this stage include: red hair, gymnastics, usernames as signatures on posts/sketches, self-portraits, pets, dreams, and styles of eyeglasses.

During the focused coding stage, the coder refined and focused our open-coding-stage codes into categories. For example, using the sampling of codes above, red hair, eyeglasses, and self-portraits merged into the category appearances. The complete list of categories generated in this step, their descriptions, and example codes can be found

in Table 1. Throughout the focused coding step, the coder concurrently labeled whether each post or comment was an attempt to earn a badge. The coder took advantage of the online nature of KidGab and integrated the coding form into KidGab itself (the form was private and visible to the research team only). All codes and labels were stored in KidGab's database for easy cross-querying during the statistical analysis phase.

In the axial coding stage, the coder noted that a few categories needed to be merged, namely the desires and possibilities categories. Many posts expressed desires using the language of possibilities. For example, one user posted: "if I could have an superpower it would be TELEKINISES.#superpower." The post was accompanied by a sketched self-portrait of the girl manipulating purple objects without touching them. The post expressed a desire to have the power of telekinesis, but the author's language was more consistent with the possibilities category. Because of the frequency of such ambiguities between the two categories, the coder merged them into a single theme during the axial coding stage.

7.4.4 Data Preprocessing: Variables

We base the presented analysis on daily counts of user activities on KidGab. Our variables, therefore represent the number of times KidGab users engaged in specific activities. The two variables below (we call this group of variables QB variables) measure participatory artifacts created by taking quizzes or attempting badges.

- *quizzes-posted-per-day* This variable is a count of the posts made to a user's wall containing the results of a quiz recently taken. These quiz posts are optional; a girl can take a quiz without posting her results. Occasionally, a girl will post the results

Identity Theme	# of Posts	Example Codes In Theme	Theme Descriptions
appearances	262	hair color, cute, self portraits	This theme captures self-presentations regarding the appearance of one's self or another person (e.g., "@username #youareawesome #loveyourredhair").
characteristics	315	funny, cool (of a person), usernames	This theme captures self-presentations regarding the personality and demographics of one's self or another person (e.g., "@username #youareawesome for being so cool and well awesome. You are so much fun to be around").
capabilities	179	triathlon, sewing, changing the world	This theme captures self-presentations regarding the skills and capabilities of one's self or another person (e.g., "I sewed an apron for my dad and I entered it in the fair and I got Grand Champion.").
preferences	270	hate, favorite, cool (of a non-person)	This theme captures self-presentations regarding the preferences and proclivities of one's self or another person (e.g., "I love Girl Scouts, flowers, and friends!").
possessions	358	have, my, mine, got	This theme captures self-presentations regarding the possessions or defining connections (family members, pets, etc) of one's self or another person (e.g., "i would hold my lizard but she won't sit on the couch #loveanimals").
experiences	204	summer camp, vacations, dreams, memories	This theme captures self-presentations regarding one's experiences or memories. Codes are sometimes explicitly stated (e.g., "Today I lifted rocks!!! they were big and heavy.... it was for our neighborhood's garden's herb spiral!!!"), and sometimes implied (e.g., "My dad is a good role model because he tells me what's safe to do and how to do it, like when him and my brother taught me to shoot a gun. #rolemodel").
desires & possibilities	269	want, wish, hope, could, should, might	This theme captures self-presentations regarding the desires and imagined circumstances of one's self or another person in the future (e.g., "I have always wanted a goldfish. If I got a goldfish I would name it Bubbles. My mom said I had a goldfish when i was 5 but I don't remember. #iloveanimals").
another's identity	163	you, she, he, proper names (not one's own)	This theme captures self-presentations regarding the identity of another person. This theme is always used in conjunction with another theme, for example a post might reference another person's characteristics (e.g., "#bestfriend my best friend is someone who is trustworthy and accepts me the way I am. Sheś super sweet and is always there for me!").
similarities and differences	129	taller, different preferences, variations in skill	This theme captures self-presentations regarding one's identity being similar to or different than another person's identity. This theme is always used in conjunction with another theme. For example, a post might reference similarities and possessions (e.g., "Cool me and you have matching purses").

Table 7.1: Themes identified through qualitative analysis of self-presentations regarding identity in posts and comments authored by child users on KidGab.

of the same quiz multiple times. On day 205, for example, one user took 6 quizzes but posted 286 quiz-result posts. To avoid skewing the results of our analysis, we remove all duplicate quiz-result posts made by a user in a day. There were a total of 368 duplicate posts removed from this analysis.

- *badge-attempts-per-day* This variable represents posts made as attempts to earn a badge. This is not necessarily the same as the number of badges earned in a day. Some badges require multiple posts and occasionally users will err in their first attempt at earning a badge, so they attempt to earn it a second or third time.

Next, we introduce the participation variables, i.e., those which measure the level of active participation on KidGab.

- *posts-made-per-day* This variable represents voluntary posts made by users per day (except the duplicate quiz-result posts mentioned above).
- *comments-made-per-day* This variable represents the count of voluntary comments made by users per day. Badge-earning announcements, which are automatically added and are stored as comments, were excluded from these counts.
- *likes-made-per-day* This variable represents the ”likes” made per day.
- *total-activities-per-day* This variable represents the sum of all afore-mentioned participation variables, plus the count of logins per day. The following variables are subsets of the participation variables, but specifically relate to the posts that included

self-presentations.

- *identity-posts-made-per-day* This variable represents the count of posts made per day that were labeled with one or more of the identity themes (Table 1).
- *identity-comments-made-per-day* This variable represents the count of comments made per day that were labeled with one or more of the identity themes.
- *total-identity-related-activities-per-day* This variable is a sum of the previous two variables.
- *total-non-identity-related-activities-per-day* This variable is a count of posts and comments per day not labeled with any identity themes.

7.4.5 Statistical Analysis

To determine the correlations of each QB/Participation and QB/Identity variable pair, we calculated the Pearson product-moment correlation coefficient (Pearson's r). To determine the statistical significance of the difference between any two dependent correlation coefficients, we calculated two-tailed Steiger's z tests.

7.5 Results

There were 755 quizzes taken, 415 quizzes posted, and 472 badge attempts in total. Quizzes taken exceeds badge attempts despite the fact that the first quiz was not released until day 92 of the deployment, and the number of badges available for earning (approximately 45) far exceeds the number of quizzes available for taking (31). In this section, we discuss the correlations between quiz-taking and badge-attempting behaviors and measures

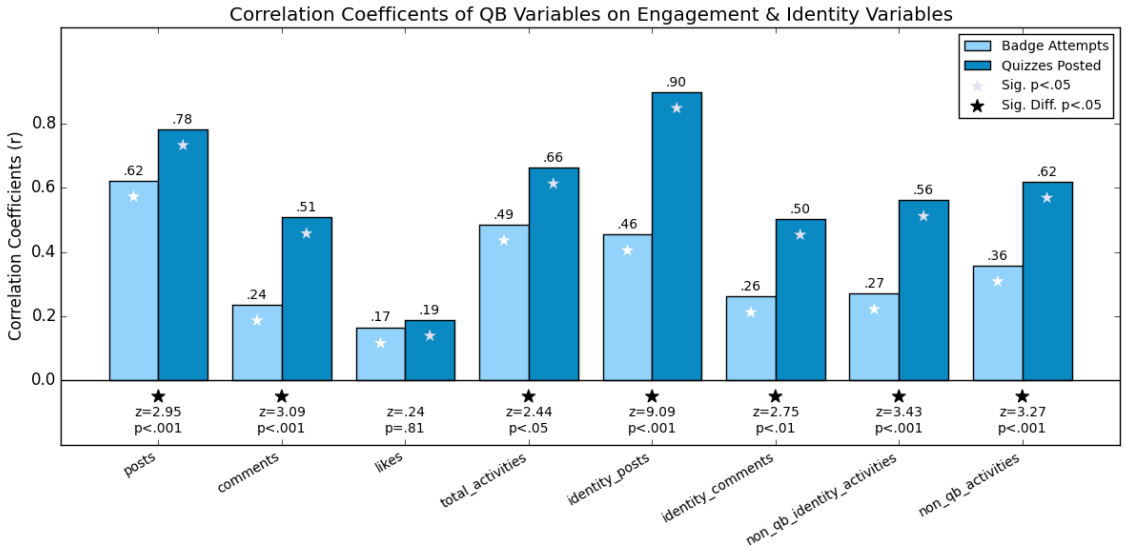


Figure 7.7: Pearson *r* Correlation Coefficients between engagement and identity variables, *quizzes-taken-per-day*, and *badges-earned-per-day*. Starred column groups have statistically significant differences between coefficients (Steiger's *z* values).

of online participation/identity conversation.

To aid in the comprehension of correlations between variables whose names may be difficult to distinguish, we provide a graphical representation of the statistical analyses below in Figures 8 and 9. The column groupings in Figure 8 appear in the order they are described in the text.

7.5.1 Quizzes vs. Badges: Online Participation

Posts

First, we consider the posting behaviors of our preadolescent users. Posting quiz results is optional and users choose to post their results only about half the time (56%). Earning a badge, however, always requires a post. The number of *posts-made-per-day* is correlated with *quizzes-posted-per-day* ($r = .78$, $p < .001$) more closely than is the count

of *badge-attempts-per-day* ($r = .62$, $p < .001$) ($z = 2.95$, $p < .01$). The increase in coefficients between *quizzes-posted-per-day* and *badge-attempts-per-day* (which was not found to be significant when the most-active 10% of users were removed from the analysis) indicates a weak user preference for posting quizzes over attempting badges. However, these correlations hold little weight, since both quiz-result posts and badge attempts require the user to make a post of some kind. Naturally the variables correlate with *posts-made-per-day*. Comments, on the other hand, are entirely optional.

Comments

There exists a strong correlation between the variables of *quizzes-posted-per-day* and *comments-made-per-day* ($r = .51$, $p < .001$). This correlation significantly exceeds that of *badge-attempts-per-day* ($r = .24$, $p < .01$). The Steiger's z test between the quizzes-taken-per-day/*comments-made-per-day* and the *badge-attempts-per-day*/*comments-made-per-day* pairing showed a significant difference between the correlations ($z = 3.10$, $p < .01$). This measure is especially powerful because neither badges nor quizzes require commenting. Furthermore, there were more badge-attempting posts than quiz-result posts on which to comment (not to mention 92 days without quizzes at all), and yet users still commented on quiz-result posts more than badge-attempting posts.

Likes and Total Activities

Our analyses show no significant differences in correlations between badge- or quiz-related variables and liking behaviors among our users though the QB variables are individually weakly correlated with *likes-made-per-day* (e.g. badge-attempts: $r = .17$, $p < .05$;

quizzes-posted: $r = .19$, $p < .05$). However, when considering the sum of activities performed by KidGab users in a day (quizzes, badges, likes, posts, comments, etc.), *quizzes-posted-per-day* correlates with the *total-activities-per-day* count ($r = .66$, $p < .001$) significantly more than does *badge-attempts-per-day* ($r = .49$, $p < .001$) ($z = 2.44$, $p < .05$).

To summarize the above paragraphs and analyses, our data shows significant correlations between quizzes-taken-per-day and *badge-attempts-per-day* for the participation variables. For posts, comments, and total activities, quizzes-posted exhibit significantly higher correlations than badge attempts, meaning that more social engagement occurs on days when more quizzes are taken.

7.5.2 Quizzes vs. Badges: Discussions of Identity

Identity Posts

Posts that include identity-themed self-presentations (*identity-posts-made-per-day*) are more likely to increase as *quizzes-posted-per-day* increases ($r = .90$, $p < .001$) than when *badge-attempts-per-day* increases ($r = .46$, $p < .001$) ($z = 9.09$, $p < .001$). The individual correlations are not surprising, since most quiz and badge posts are considered identity-related.

Identity Comments

Comments, however, as discussed in the previous section, are entirely optional and often reference identity (about 55% of comments reference identity in some way). Comments coded with one or more identity themes (*identity-comments-made-per-day*) correlate significantly more with *quizzes-posted-per-day* ($r = .50$, $p < .001$) than with *badge-*

attempts-per-day ($r = .26$, $p < .001$) ($z = 2.75$, $p < .05$).

Non-Badge & Non-Quiz Activities

To remove the direct impact of quiz posts and badge attempts from posts and comments, we tested counts of non-quiz- and non-badge-related activities (non-QB activities). Following the trend, *quizzes-posted-per-day* correlates ($r = .56$, $p < .001$) significantly more than *badge-attempts-per-day* ($r = .27$, $p < .001$) ($z = 3.43$, $p < .005$) for identity-related non-QB activities. The results are similar for the total-non-QB activities, which can be but are not necessarily identity-related. Also, *quizzes-posted-per-day* correlates ($r = .62$, $p < .001$) significantly more than *badge-attempts-per-day* ($r = .36$, $p < .001$) ($z = 3.27$, $p < .001$). These results indicate that as both badge-attempts and quiz-result posts increase, participatory activities (not including those posts) also increase significantly. However, quiz-result posts are associated with a sizably larger participatory increase than badge attempts.

Activities in Identity Themes

Specific identity theme activity variables (activities labeled to reference at least one of the identity themes) likewise show a tendency to correlate more with *quizzes-posted-per-day* than with *badge-attempts-per-day*. All nine identity themes correlate significantly with *quizzes-posted-per-day* ($r = .22$, $p < .05$). Only five of the nine identity themes correlate significantly with *badge-attempts-per-day*. Quiz posts correlate with every identity theme more than badge attempts, but only significantly more for three identity themes. Two-tailed Steiger's z tests require both correlations being compared to be significant,

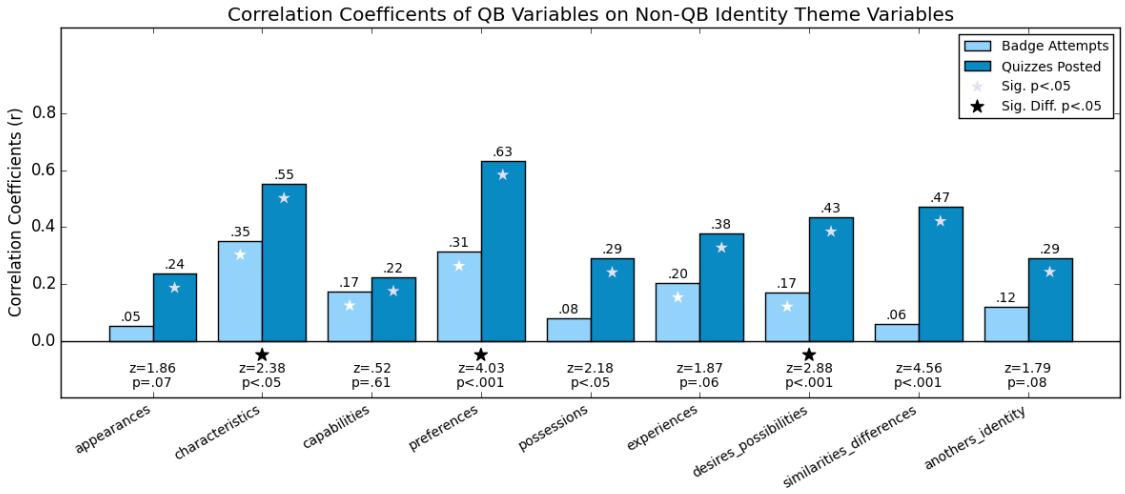


Figure 7.8: Pearson r Correlation Coefficients between identity themes, *quizzes-taken-per-day*, and *badge-attempts-per-day*. Starred column groups have statistically significant differences between coefficients (Steiger's z values).

making this number (3 out of 9) misleadingly low. The greatest disparity between quiz-posting/badge-attempting and identity-theme variable correlations was found for the Similarities and Differences theme (*quizzes-posted-per-day*: $r = .47$, $p < .001$; *badge-attempts-per-day*: $r = .06$, $p = .45$). Specific correlation coefficients (rs) for all identity theme variables and the QB variables can be seen in Figure 9.

In summary, self-presentation activities generally adhere to the trends identified in the online participation analysis above. Posts and comments that contain themes of identity correlate significantly with both quizzes-taken-per-day and *badge-attempts-per-day*, but correlate significantly more strongly with quizzes-taken-per-day. When we omitted the posts and comments that directly attempt to earn badges or share quiz results, the resulting subset of activities still correlated more strongly with quizzes-taken-per-day than

with *badge-attempts-per-day* for both the total-non-QB activities and the non-QB activities that reference identity. Among the identity themes, *quizzes-posted-per-day* correlated significantly with all nine themes, and *badge-attempts-per-day* correlated with only five themes.

7.6 Discussion

Here, we revisit our four hypotheses and position our results within the (limited) existing literature surrounding youth and their participatory behaviors with digital media.

7.6.1 Hypothesis 1

Firstly, we hypothesized a significant positive correlation between personality quizzes and online participation on KidGab. Our data revealed that *quizzes-posted-per-day* correlates highly with *posts-made-per-day*, *comments-made-per-day*, and *total-activities-per-day*. The contribution of our results in regard to this hypothesis is twofold. First, though other researchers have anecdotally mentioned that adults and youth alike enjoy taking personality quizzes [18, 33, 216], this work provides significant quantitative evidence of the popularity of this feature in social networks, particularly for girls in our age range of 7-12 years. The second contribution of our findings in relation to this hypothesis is that taking quizzes correlates positively and significantly with overall participation on KidGab. Though we have not shown that taking quizzes causes increased participation, our evidence of correlation leads us to speculate that this may be the case. In future work, we intend to study whether the quiz taking/posting behavior occurs before each of the other

activities in a session (thus building a quantitative base for the study of causation) as well as perform qualitative interviews and focus groups with KidGab users to understand their quiz-induced motivations. The confirmation of this hypothesis, though the simplest in this work, lays the foundation work for H2, H3, and H4.

7.6.2 Hypothesis 2

Secondly, we hypothesized that there exists a significant yet weaker positive correlation between badges and social engagement. Similarly to quizzes, we found that *badge-attempts-per-day* does correlate significantly with *posts-made-per-day*, *comments-made-per-day*, and *total-activities-per-day*, but the correlations were significantly weaker than those with *quizzes-posted-per-day*. Confirming the conclusions of boyd [18] and Stern [195], posting about culturally relevant topics (and thus earning badges) is indeed a popular pastime among girls on KidGab. The girls in our study on average posted .82 badge-attempting posts per session-day. However, the rate of participatory decline (correlation of daily participation rates to days-since-cohort-released) was found to be significantly stronger in the number of girls attempting badges than in the number of quizzes posted per day (participatory decline for badge attempts: $r = -.39$, $p < .001$; participatory decline for quiz posts: $r = -.21$, $p < .01$; $z = 2.05$, $p < .05$). This shows that girls lose interest in badge-attempting significantly sooner than they lose interest in taking and posting quizzes. Our results show that the activities youth desire to participate in change over time, slowly drifting toward the activities which elicit more feedback (i.e. quiz posts elicit significantly more *comments-made-per-day* than badge attempts). With our analysis,

we have shown that there is a desire to "write oneself into being" [4, p129], but that such a desire may be less strong and long-lasting (in terms of overall site participation) than the desire for feedback.

7.6.3 Hypotheses 3 & 4

Next, we hypothesized that personality quizzes encourage conversations about identity and that badges similarly encourage identity conversation but to a lesser extent. Through our analysis, we found that *quizzes-posted-per-day* correlates significantly (and significantly higher than *badge-attempts-per-day*) with identity-themed posting and commenting behavior, even with comments on posts that that are not quiz-results or badge-attempts. We discuss two major arguments for this to be the case: firstly, we discuss risk minimization and secondly, we discuss the advantage of shared experiences.

First, we posit that the transfer of authorship from a girl to the unnamed quiz writer promotes identity-themed online conversation. In the first place (posting comes before commenting), posting quiz results (anonymously-authored short paragraphs "custom"-written about the quiz-taker) is much less risky and more prospectively advantageous to a girl's online identity than posting a similar but self-authored paragraph, like one written to attempt earning a badge. For example, the quiz results shown in Figure 4 regarding what kind of pet a girl should bring to Hogwarts could be quite similar to an attempt to earn the Tails of Love badge, which encourages girls to draw and describe a pet she owns or wants. In our study, 13 girls posted the results of this quiz since its release on day 143 of 228, yet only 10 girls have attempted to earn the badge, despite its initial release on day 9 of 228,

nearly four and a half months prior. Certainly clicking a few buttons to take a quiz is easier than writing a short paragraph, but the published works in support of the acute desire to express one's identity through words [18, 195] indicate that ease might not be a primary factor. Instead, we argue, that our users chose to participate more in quizzes because it reduced the risk for disapproval or unrelatableness, thus maintaining one's membership in the collective conformity [34, 195].

Second, the standardization of the personality quizzes provides girls a shared experience to discuss. Research in both the real and virtual worlds show that people are likely to center conversations around shared interests and experiences (e.g. [48, 32]. Such shared experiences are provided by quizzes but not necessarily by badges. For example, one girl (we will call her Amy) posted her results to KidGab's "Which Disney Pixar Sidekick are you?" quiz. Amy received "Joy, from Inside Out" as her Pixar sidekick result. Another girl commented on the quiz result post, "Cool! I love that movie! Me and you go[t] the same thing!" Because both girls took the quiz and thus had a known shared experience, they were able to begin a conversation about their movie preferences and the similarities in their personalities. This "you got x, I got y!" commenting behavior is very popular among KidGab's users, as evidenced by the large number of activities referencing similarities/differences in Figure 9 (also note the disparity in correlations between quiz-posting and badge-earning behaviors). Talking about the shared experience of taking quizzes provides a conversational starting point that may not exist when attempting badges. One girl's mention of triathlon training when attempting the Active Girl badge (post about something

active you did today) will likely not elicit a response from other girls unfamiliar with the sport of triathlon.

7.7 Limitations

There are four principal limitations of this work. Firstly, though a sample size of 80 children was sufficient to find relevant results, more users would ensure greater confidence in the generalizability of our findings. Second, our all-female population of participants (further limited by Girl Scout membership) may not reflect the motivations, preferences, and behaviors of all preadolescent youth. KidGab itself, despite its abundance of advantages, has two distinct limitations. The site is under constant development, meaning that micro-improvements and occasional extensive upgrades and feature releases (such as the introduction of personality quizzes) happen at least weekly. This means that each girl experienced KidGab slightly differently, which could potentially impact patterns of usage. Finally, because members of our research team are active participants on the network, their participation is undoubtedly an influence on the community, an influence that cannot be entirely removed for analysis.

7.8 Conclusions & Contributions

In this study, we analyzed the correlations between two little-studied social networking features: personality quizzes and badge-based reward systems on the levels of participation and identity-related artifacts captured by our online social network for preadolescents, KidGab. We found *quizzes-posted-per-day* to correlate more strongly with both on-

line participation and identity conversations, than does *badge-attempts-per-day*. We have presented many conclusions and contributions, but the following two ideas summarize our main points:

- Though youth are indeed interested in self-reflecting via textual compositions, on a daily basis, they partake more in personality-quiz style activities that provide them instant feedback and shared experiences with other users.
- Identity-themed conversation tends to follow conformity and sameness of experience. When youth know that they share experiences and clear similarities/differences with other users, they are more likely to engage in conversation.

These contributions provide other researchers a quantitative account of previously singularly qualitative results. Our results provide "micro-level" accounts of what youth actually do on a social network on a daily basis, whereas similarly motivated qualitative studies provide "macro-level" accounts of how and why youth participate in those activities. On a general timeframe, previous studies have suggested that primary motivations for youth to participate in online communities are the desires to self-present, self-reflect, and write one's unique (yet conforming) identity into being [18]. However, we found that on a daily basis, youth will participate in the simplest activities that 1) minimize risk of being un-relatable or non-conforming and 2) are more likely to obtain feedback from other users. This may indicate some disparity in what youth say they do and what they actually do, or it may simply indicate that immediate motivations and actions differ from the greater goals and directives youths use to explain their actions.

This chapter provides insight into two of KidGab's integral affordances (personality quizzes and badges), but we have learned a great deal about many other facets of both online social networking for children and the trials and tribulations of deploying one's own social networking site. The following chapter outlines those trials, tribulations, and triumphs, collected from 458 days of deployment.

8 LESSONS LEARNED FROM 458 DAYS OF DEPLOYMENT

8.1 Introduction

The participatory interest and affordance adoption on children's social networking sites are virtually unstudied topics in the great world of research. This may be attributed to the many laws in place protecting children's online privacy. Social networks and researchers alike must adhere to a complicated consent process before children can even use their sites. Additionally, researchers must comply with similarly complex consent and assent procedures in order to use the collected child-authored online data for research. In lieu of exerting such effort, mainstream social networks frequently forbid children under the age of 13 from joining, and researchers instead study older teens and adults. Several researchers have explored children's preferences and tendencies in virtual worlds (e.g. [8, 6, 162, 166, 176]) and likewise with highly specialized communication modalities (e.g. [76, 1, 81, 158, 141, 125]), but research regarding children's social networking behaviors remains scarce, particularly research based on data collected from the social networks themselves.

It makes sense, then, that the first brave sailor to attempt sailing in uncharted seas might make just a few mistakes along the way. In this manuscript, we report six of our grandest mistakes in the design, development, and deployment of our own social network for kids, KidGab. We discuss the ineffectiveness of gamification in procuring participation among our child users and the rarity of parental supervision on the site. We discuss

how our average user lasts only 5 hours and how our inadequate server once crashed and remained unserviceable for six full days (with quite dramatic timing, we might add). We have certainly made faulty assumptions about the results we would find and we report those assumptions here. However, we additionally report the solutions we found for those issues, and the lessons we learned across 458 days of continued, active deployment. (Except for those six days, of course.)

In this manuscript, we share our experiences designing, developing, and deploying our own social networking site for children — the successes as well as the failures — in order to begin filling the great knowledge gaps described above.

8.2 KidGab: Design & Development

Over the last four years, we have incrementally designed and developed our own social networking site for children aged 7 to 13 years, called KidGab. To summarize Chapter 4, KidGab is intended for small mentored communities of children such as sports teams, schools, school districts, scouting councils, etc. We designed KidGab to be a fully-featured CSNS, including affordances for unrestricted textual posting, unrestricted textual commenting, @mentions (tagging other users in one's posts), image upload, "like" functions, groups, chat rooms, and more. Contrary to the design of several social networking services for children, we chose not to impose severe restrictions upon our users. We desired to provide our users active practice with the tools they will encounter on adult social networking sites in the expectation that they will learn to use the tools with mindful moderation and

safe expressiveness. An underlying principle that guided us throughout the development process was that cyberbullying and other cyberthreats should be prevented through the acquisition of appropriate social networking skills rather than prevented through lack of venue.

8.2.1 KidGab's Affordances

Textual Communication. KidGab allows unrestricted textual communication among its users in the form of public messages (wall posts), private messages (similar to email), and comments. Though the decision not to restrict communication is contrary to many online social networks for children, we believe freedom of expression allows our users to feel autonomous. The feeling of autonomy has been shown to increase intrinsic motivation in digital activities [172]. Additionally, most social networks for adults (13+ years) have unrestricted textual communication, so imposing restrictions (such as selecting from canned messages or requiring all words to be spelled correctly) would provide an unrealistic learning environment that limits a child's ability to explore and make mistakes.

Sketching. On KidGab, users can send messages textually or pictorially. Users can compose images using KidGab's sketch interface and then post their artistic masterpieces to their own or their friends' walls. Sketches are not stored as mere images, rather they are stored as short videos that replay the sketch composition from start to finish. This functionality allows for multi-scene storytelling and simple animations.

Badge System. KidGab's extrinsically motivated badge system is called the "Digital Sash". The Digital Sash, explained in full detail in [206] provides users with simple tasks

Figure 8.1: Complete view of the Digital Sash, the Digital Sash in explore mode, and a post which earns the badge explored.

to sketch or write a post in accordance with a particular topic. New badges are released daily or bidaily over a period of four weeks following a user's registration on KidGab. The tasks are designed to be appropriate conversation-starters for discussions on social media such as fun favorites ("What's your favorite X?"), recipes, global awareness, and signs of friendship. Such a reward system could take many forms in terms of artwork [206], but we have chosen the well-understood and contextually-appropriate Girl Scout sash as our badge metaphor. (More details about our deployment with our local Girl Scout council follows in the next section). To access her Digital Sash, a user navigates first to her profile page and then clicks a 'tab' labeled "My Sash". There, she sees a sash similar to that in Figure 8.1(a). Badges yet to be earned appear in grayscale, while already-earned badges appear in color. To learn how to earn a badge, she simply clicks on it and a lightboxed description of the task appears over the sash. The example in Figure 8.1(b) displays the Museums are Awesome badge. The task for this badge is to describe something interesting seen or experienced in a museum. Somewhere in the post, the user should write "#museum" (hashtags make it possible for KidGab to automatically award badges). One of our child participants earned

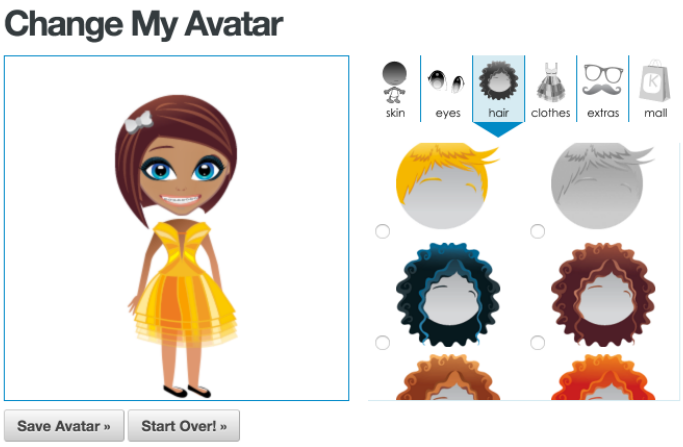


Figure 8.2: KidGab's Avatar Creator. Our original avatar creator provides options for millions of combinations of skin, eye, clothing, hair, and environmental features.

the Museums Are Awesome badge with the post in Figure 8.1(c). The user remarked, "[At the] franklin institute in philadelphia [I] leaned about newton's first law of motion – inertia #museum". She accompanied the text with a sketch of a red apple.

8.3 KidGab: Deployment

In keeping with KidGab's aim to be used by closed groups of children, we intended the pilot studies of KidGab to be deployed within a troop of Girl Scouts (similar to the gymnastics team utilized by [76]). We approached our local Girl Scout council with the request to deploy KidGab to one or two troops of girls. We offered to present an original, four-hour workshop (called a #DigitalFriendship Workshop) to the girls, in which we teach skills of healthy digital citizenship and digital expression through hands-on activities. One such hands-on activity in the workshop's curriculum is a tour through KidGab. The Girl Scouts readily accepted our proposal and so began our partnership.

In October 2014, we began our initial deployment with a group of 7 Girl Scouts

and their parents from a small town neighboring our university. This deployment lasted eight weeks, after which the site was taken offline. We do not refer to this deployment in our analysis except anecdotally. Our relationship with the Girl Scouts provided us such potential for growth that we chose to continue deploying KidGab within that organization rather than starting over with another organization (such as a school or sports team).

The second and more longitudinal deployment of KidGab began on March 8, 2015 with a cohort of 16 girls from another nearby small town. The second deployment (hereafter referred to as simply "the deployment") continues through the time of writing — approximately 400 days later. In those 458 days, we have introduced KidGab to about 15 cohorts of girls through our #DigitalFriendship workshops. Additionally, beginning in June 2015, we opened registration to any Girl Scout who provided an active Girl Scout (GS) membership ID number and online signatures of consent/assent to participate in research. Total, KidGab has a roster of 271 GS users aged 7 to 16 years (some troops included older girls, whom we chose not to exclude). The mean age across our user base is 11 years.

8.4 Our Assumptions and Why We Were WRONG

In the following sections, we discuss the lessons we have learned in our nearly 400 days of CSNS deployment. Specifically, we address six faulty but intuitive assumptions we made at the start of our project and how those assumptions have been proved wrong over time.

8.5 Incorrect Assumption 1: Deployment Has Begun! Time To Observe!

Prior to our pilot deployment in October 2014, we (naturally) ensured that the system was as bug-free and fully-featured as possible. KidGab had undergone informal large-scale testing as the content management system in an undergraduate classroom. We fine-tuned the sketch functionality to include fewer colors and options to provide users some consistency in their sketches. We confirmed that the custom avatar creator had sufficient expressiveness for users with varied hair, eye, and skin colors, as well as a wide range of clothing choices. We developed and tested the Digital Sash and wrote the first few badge prompts. KidGab was ready.

Inspired by the work of Inkpen et al. [76] and many other researchers (e.g. [124, 128]) who received immediate and enduring displays of interest from their child users (not to mention the great fabled preteen interest in Twitter, Instagram, etc.), we fully expected KidGab to experience constant flurries of activity and silly conversations. When KidGab was in the hands of the children, we believed we could sit back and observe our hard work paying off. We were wrong.

KidGab's development was never complete. Badge prompts for the Digital Sash needed to be authored and released every single day. There was always a user requesting new outfits, bracelets, or hair styles for the avatar creator; always a girl who forgot her password but has no email address through which to acquire a new one; and always a friend or colleague suggesting "Wouldn't it be awesome if KidGab could do X?!" In short, there was *always* more development to be done and more content to be written. Requests

for content were not solely granted for the sake of satisfying the requester. They were granted for the sake of continued activity on the site. In fact, if we failed to continue developing KidGab or enlivening it with new content, the overall activity experienced by the site suffered significantly.

Consider, for example, the release of new avatar components which occurred on 14 unique days of KidGab's deployment. The number of "likes" made (per user, per day) within three days of the release of new avatar components was significantly greater than the number of likes made on all other days (3-day mean=3.09 likes, all other days (AOD) mean=1.66 likes, ANOVA=5.62, $p < .05$). Mean liking behavior was significantly heightened within 1, 2, 3, 5, even as far as 7 days after the release of new avatar components (7-day mean=2.73, AOD mean=1.62, ANOVA=5.62, $p < .05$).

Another example of site activity being contingent on new content was the relationship between the release of new quizzes and badge-earning behavior. Though these two items were far less related than the two in the prior paragraph (it makes sense that a user would like the new avatars or mall purchases of another user), they were nonetheless similarly affected by one another. Within one day of a quiz release, users earned nearly double the number of badges than on all other days (1-day mean =0.58 badges, AOD mean=0.37 badges, ANOVA=5.79, $p < .05$). This increase remained significant for three days following the quiz release (3-day mean= .0.58 badges, AOD mean=0.37 badges, ANOVA=5.79, $p < .05$).

Since the first quiz was released on day 90 of the experiment, we observed that the

number of girls who logged in to KidGab per day dwindled as the number of days since the last quiz release grew. (Pearson's $r = -0.17$, $p < .005$). Stated simply, if we didn't released a new quiz, girls probably wouldn't even log in.

Given this relationship between new quizzes and login activity, as well as many other similar observations, we conclude that ***if we do not continually add new content and features, interest in the site decays into nothing.*** Sitting back and observing the site flourish without a great deal of upkeep is a fantasy.

8.6 Incorrect Assumption 2: Rewards Will Get The Kids To Participate! Gamification Works.

Originally, in the 8-week pilot deployment, KidGab's Digital Sash included only post-to-earn-type prompts. After monitoring the site every day, and realizing the badges were pretty unpopular among our users, we decided to re-analyze our literature to understand just what we were doing wrong: The Digital Sash provided structured and incremental goal setting [118]. (Check.) It promoted a sense of similarity between a user and the other members of the community [5]. (Check.) The quantity and quality of badges earned could contribute to a user's online reputation [14]. (Check.) The badge requirements instructed new users about appropriate behaviors and valued activities within the community [5]. (Che— wait. Not check!)

Our solution was to add a set of badges that promoted active participation on the site — activities like comments and @mentions (KidGab uses the Twitter-like @mention style

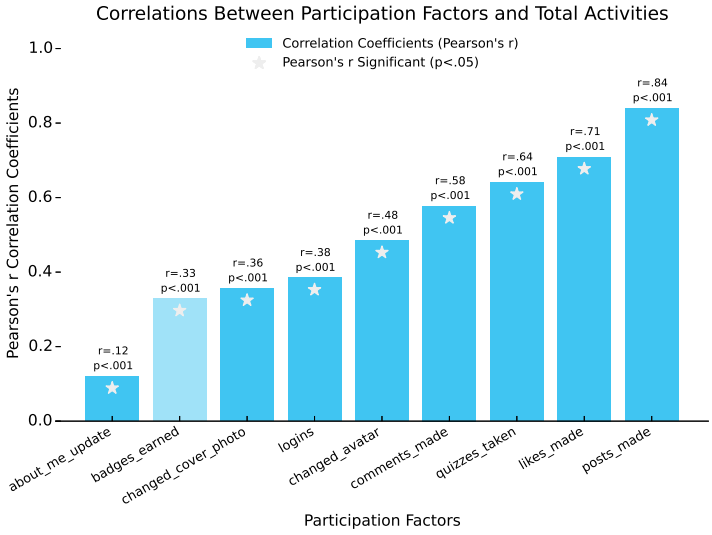


Figure 8.3: Pearson's r correlation coefficients between participation activities and the total count of activities completed per user per day. Badges earned (highlighted) correlated much less with total activities than did all of the other individual activities, save one.

of communication with other users). We created 7 such badges, seen in blue just below the patch with the stripes and emoticons (See Figure 8.1). Despite this, the interest in badge activities remained lackluster in comparison to the other activities on the site. The correlation between the number of badges earned (per girl per day) and the total activities completed (per girl per day) was merely 0.33, $p < .001$. While the badges-to-total-activities correlation was significant, Figure 8.3 shows that the number of badges earned correlated quite a bit less than the other affordances of participation. Our conclusion was that ***badges just don't work very well as participation motivators.***

We devised an entirely new plan: a currency system, called KidGab Coins. We knew that children the same age as our users were acutely focused on defining and exploring their identities [18, 195] and, given the requests of several girls for avatar components like angel wings and rainbow hair, we knew that girls liked to change their avatars to reflect their

preferences. We decided to allow the Coins to be used to purchase not just the specialty avatar components including the requests above, but also pets, earrings, costumes, accessories, backgrounds, and more. The elements sold in the mall allowed users to personalize their avatars beyond what everyone else had. The desire to conform is strong [195], but the desire to stand out in a socially acceptable way is also desirable [34]. A user can have cool and unique items for her avatar, but she needs to earn them. From such ideas, the KidGab Mall was born, and it made a significant difference in participation (for better and for worse)!

Since the grand opening of the KidGab Mall, users:

- authored more comments (before mall mean=0.25 comments (per girl, per day), after mall mean=0.56, ANOVA=4.91, $p < .05$);
- taken more quizzes (before mall mean=0.50 quizzes, after mall mean=1.52 quizzes, ANOVA=16.66, $p < .001$);
- posted more quizzes (before mall mean=0.26 quizzes, after mall mean=0.95 quizzes, ANOVA=14.34, $p < .001$);
- and liked more activities (before mall mean=0.86 likes, after mall mean=2.18 likes, ANOVA= 66.49, $p < .05$);
- but also earned fewer badges on the Digital Sash (before mall mean=1.45 badges, after mall mean=1.22 badges, ANOVA=23.42, $p < .001$);
- and made fewer cover photo changes (before mall mean=0.78 cover photo changes, after mall mean=0.35 cover photo changes, ANOVA=25.92, $p < .001$).

Interestingly, opening the KidGab Mall did not significantly alter avatar-changing behavior. It did, however, fulfill its intention of increasing overall participation on the site (the sum of logins, posts, comments, likes, badges earned, quizzes taken, avatar changes, about-me changes, and cover photo changes) (before mall mean=8.27 activities per user per day, after mall mean=10.59 activities, ANOVA=4.33, $p < .05$).

To wrap up the discussion of these experiences, we conclude that motivating voluntary participation on an online social network for kids is very difficult. ***Tapping into kids' preexisting desires to explore and define their identities while also making the things that are worth having simultaneously worth working for will lead to more participation in the long run.***

8.7 Incorrect Assumption 3: Kids Will Express Themselves!

In the first few months of both the pilot and second deployments, we held great hopes for our Digital Sash. We thought the badge prompts would be fun and educational. We thought daily badge-release announcements would remind our users to log in. We thought the opportunity to express opinions and other various self-presentations relating to identity would be highly motivating for children. After all, teenagers report that identity definition and self-presentation are the most motivating online activities [195, 18]. Kids will relish in the Sash activities, we thought. They will log in every single day to earn the new badge. We thought wrong.

Badges were not *entirely* unpopular. About 41% of our users earned at least one

badge. A user earned on average 1.74 badges total across all her active days (standard deviation=5.06 badges), and an average of .45 badges per active day (standard deviation = 1.31 badges). These statistics are tolerable, but far lower than our expectations.

Interest in personality quizzes sharply contrasted Digital Sash interest. The quizzes only included artificially personalized content and no self-expression While badges were self-explorations authored by the user herself, personality quizzes were self-explorations authored by another. Though we knew personality quizzes were considered popular, we had no expectation of them proving more popular than badges. An average user took 5.07 quizzes (standard deviation= 11.55 quizzes) across all her active days and took about 1.30 quizzes (standard deviation= 3.50) per active day. These significant increases in mean activities over all days (ANOVA= 18.64, $p < .001$) and per day (ANOVA= 54.57, $p < .001$) are just the beginning of the story.

In an analysis performed on day 250 of the deployment, we found that posting personality quizzes correlated significantly more with commenting behaviors than did attempting badges [204]. Additionally, users lost interest in earning badges much faster than taking and posting quizzes. Following our analysis, we concluded that children are indeed motivated to earn badges, and upon first joining the site, they earn several. However, over time, the instant feedback of quiz results and the higher propensity to receive comments on quiz result posts becomes more motivating to our users than badge activities.

By definition, self-presentations are made to elicit approval from others [58], and our research shows that this need for positive feedback and approval (provided by both the

quiz results and peer responses) outweighs the need to explore and describe one's opinions and experiences. The moral of this story: ***motivating children on CSNS via opportunities of self-expression is less successful than motivating them via peer feedback***. The two motivations are not mutually exclusive — in fact, affordances designed to leverage those motivations might be nearly identical. However, a CSNS designer needs to understand the distinction and design accordingly.

8.8 Incorrect Assumption 4: The Kids Are Never Going to Leave!

Speaking of the difficulty of engaging voluntary participation on a children's social network... One of the most surprising results gained from nearly 400 days of deployment is the varied and fleeting interest of our child participants. Unlike other, more structured research regimes, we relied on children to engage with our system voluntarily and in their own time. We did not have the luxuries of a formal classroom setting for securing organized and widespread participation [97, 96, 167, 207], or the benefit of a deployment fleeting enough to make access to such a system a novelty [76, 124]. Our goal was to observe a social network for children "in the wild," and such we have done.

Children gained and lost interest in KidGab quite quickly — though some sooner than others. Among all 271 users included in this analysis, the median time of engagement (time between first and last logins) was a mere 0.25 days, or approximately 6.0 hours. In fact, the ratio of users who lasted four hours or less (KidGab automatically logs a user out after four hours) is a staggering 47%. Among the 53% who did surpass the four-hour

threshold, the time of engagement is rather lengthened. Among those users, the median time of engagement was 10.24 days and the mean was 59.94 days. We note that these are not measures of quantity — a girl may have logged in only twice in 100 or more days — but the measures reflect the duration of time that KidGab proved interesting enough to induce a girl to log in.

The motive for sharing these values, which could be thought to shed unfavorable light on our methods or our results, is to communicate that children's opinions can be fickle and their interests can rise and fade in an instant. One day, a girl can post with all the exaltation that all-caps and emoji can convey, "OMG! I so totally ADORE this site! I love it!! :D!!" and then never log in to the site again (this is a direct quote from a post by a girl in her last login session on day 274 of our deployment). The "fault" — if one should call it a fault — of fleeting participation is not on the CSNS designer for somehow creating features and affordances that are not exciting enough to maintain long-term participation. Our affordances and features *do* sustain long-term participation as would those of many similar systems. However, ***when participation is voluntary, some children will choose not to participate long-term*** (either by their own volition or their parents'), and such a choice is rather to be expected than not.

8.9 Incorrect Assumption 5: Parents Want To Be Involved!

Similarly to all the other assumptions presented here, the section title is not 100% false. Parents do *want* to be involved. At the very least, the parents with whom we commu-

nicated regarding the topic *said* they wanted to be involved.[1] What parent would say they didn't want to be involved when a scholar in children's social networking tells them that parental involvement decreases their child's chances of cyberbullying perpetration/victimization [136], their likelihood of being manipulated into meeting an online predator [193], or their propensity to share too much personally identifying information about themselves [165]? Parents indeed want to be involved, but desire does not generally translate to action.

As mentioned in the KidGab system description above, child activities on KidGab were built with the intention of being transparent to parents. Attention was given to provide parents easy monitoring strategies and even login blocks so children could not continue unsupervised by a parent for too long. The login blocks, a default setting for children with parent accounts until day 214 of the deployment, required parents to log in every 7 days or their child would be prevented from accessing KidGab. After day 214, the default setting was to prevent child access after 30 days of parental inactivity. However, these considerations proved unused in the general case. There were 271 child KidGab users who logged in at least once. There were only 114 total parent accounts, and only 68 of those actually logged in. In the nearly 400 studied days of KidGab's deployment, parent users logged in a total of 199 times. The 68 parents who did log in belonged to 69 of our child users (parents can have more than one child and vice versa). Thus, only 25% of our child population had a parent who logged in at least once. The percentage drops to 13% when the minimum number of parent logins increases to two.

[1]Naturally, this sample is biased, since we lack the right to discuss our experiences with those parents who refused their consent to participate in this research.

Not all parents chose to abstain from participation, however. Several parents logged in more than five times. Two such parents logged in more than 10 times, frequently ensuring the safety of their children's online social activities. One parent sent a message to the KidGab Admin (the first author) which began, "Thank you so much for this site. My daughter wants to be connected, but I'm way too nervous about the rest of the world!" The remainder of the message requested the location of a resource we'd recommended for families in the name of cyber-safety. The sentiment that KidGab was a safe space for her daughter, as well as the request for further resources, indicated her great interest in participating in her child's online safety.

Amanda[2], one of our child users — in fact our most active and long-lasting user who joined on the day of KidGab's release and logged in a total of 179 of the 394 days included in this analysis (logging in on both day 1 and day 394) — was among those without a parent account attached. A brief phone interview with Amanda's mother revealed that she was very pleased with KidGab and the security it provided, but no more was said regarding her own desire to contribute to that security. Later, Amanda sent a message to the KidGab Admin stating, "... your a great Kidgab creater. I like Kidgab because my mom does[n't] let me have other social medias because she says that they are not safe but she trust you on Kidgab". Perhaps this hints at an explanation for the lack of parental participation. It is possible that the daily monitoring by the research team and our zealous descriptions of KidGab's safety features make parents feel their assistance is unnecessary.

The contribution of this assumption, the assumption that parents are not generally

[2]Name changed for anonymity.

engaged in the online social networking behaviors of their children, is similar to that of the previous section. Parents should be able to choose in what manner and degree they participate in their children's digital lives. Sometimes parents will choose to participate, but more often they will not. ***Though parents are the first line of defense in the battle against cyberthreats, their participation is not the only pillar on which a children's social network can stand.***

8.10 Incorrect Assumption 6: Any Old Server Will Do. We're Still A Small Site!

The idea that one must use adequate server technology to host a social network seems quite obvious, but the consequences of choosing a server that is merely adequate can cause major losses in participation.

The server that hosted KidGab from its pilot-testing stages through day 94 of deployment was a small virtual machine upon a Dell PowerEdge R720 with dual four-core Xeon processors, 352GB of RAM, two SAS 146GB drives, four 1GB onboard network connections and two additional four-port network cards. This very powerful machine was hosted by a sister department at our university and hosted 77 virtual machines, many managed by undergraduates who used the computational power to perform large-scale calculations for their course projects. KidGab was a small community and its demands on the system were not very great. We reasonably assumed a small virtual machine with no dedicated resources would be adequate.

One fateful Saturday, a Saturday on which we hosted a #DigitalFriendship workshop

for a group of 15 new KidGab users, our server failed. Indeed, it was not our own configuration that failed, but rather the entire machine. All 77 virtual machines were taken offline due to an internal DNS issue. The outage began within an hour of the workshop's conclusion and lasted for 6 full days. Generally, within 10 days following a workshop, about 46% of participants choose to continue participation on KidGab. This particular cohort of girls yielded only 27% (four out of 15 girls). From an experimental standpoint, the cohort was a near-failure. Later conversations with girls in the cohort (not among the four returners) led us to understand that they tried to log in several times, but were never able to reach the site, and thus soon gave up.

Now, KidGab is hosted in a managed VMWare infrastructure. The infrastructure consists of eight servers that are located in two sites. The sites are connected by redundant fiber connections. Each site also has backup power provided by battery systems at each server and diesel generators at each building. Each server has 262GB of RAM, 24 logical processors running at 2.2Ghz each, and redundant 10Gbit networking. All the servers are connected to a common storage infrastructure. KidGab consumes a small share of those resources: 16GB of RAM and 4 virtual CPUs. Each piece of the infrastructure has built-in redundancies. Storage is configured to allow maintenance and disaster recovery without bringing machines down. Lastly, but equally importantly, the VMWare infrastructure upon which KidGab runs has a dedicated management team that continually monitors its hardware, networking, and security. This team works tirelessly to prevent any outages, let alone outages lasting six days, from ever happening again.

We have learned to be overly cautious. Our server cannot be merely "adequate." The server structure and the team that support it need to understand that reliability and uptime are the number one priority. ***Unreliable accessibility and server downtime drive away otherwise willing and interested CSNS users.***

8.11 Conclusions & Contributions

Designers of social networks for children have very few (if any) published accounts of various interface affordances and their participatory appeal among users in deployed systems. For that reason, we have compiled this list of the intuitive but faulty assumptions we made when building our own social network for kids, KidGab. Our six main contributions to the field of user interfaces and children, our six nuggets of advice to future CSNS designers are:

1. In order to maintain active participation over time, new features and content need to be released and announced frequently.
2. Gamified digital badge systems will not increase participation, but a currency system which leverages children's acute desire to explore their identities does increase overall participation on the site.
3. Though teens say their major motivation when communicating online is to define their identities, the prevailing motivation we witnessed is the desire for positive feedback.
4. Children's interest in CSNS can be fleeting. Our median user remained active for a

mere five hours, but those who remained interested for more than four hours tended to remain active for nearly ten days.

5. Parents want to be involved in their children's online social networking behavior, but they will not generally act on that desire.
6. You're only as reliable as your server. Ensure that your server architecture and technical support team understand the necessity for your social network to be considered "production code." Uptime is essential to collect quality data and downtime drives away users.

In future work, we will continue KidGab's deployment for (hopefully) another 400 days. We will seek more users and more data regarding their usage and preferences of the affordances we provide. We hope to increase our affordances to include collaboration spaces, user-managed boutiques in the mall, and several cyberbullying themed games (think rainbow unicorns meet evil cyberbullying text bubbles). Should we intuitively but incorrectly assume anything else, we'll be sure to keep you posted.

9 CONCLUSION AND SUMMARY OF CONTRIBUTIONS

In this manuscript, we have discussed five major lenses through which to consider social networking for children:

1. How should social networking designers build online social networking affordances for child users?
2. What are the detailed affordances and functionalities of a system built upon those design principles?
3. How do children adopt and reuse the ideas of others on online social networks for children?
4. What roles do gamification, personality quizzes, and identity exploration play in the participation rates of children on online social networks?
5. Following 458 days of deployment, what have we, as children's social network designers and administrators, learned about creating and maintaining an online social network for children?

We will review our contributions from each of these lenses individually, and then discuss the corollary and miscellaneous contributions which do not fit within the confines of one single question.

In Chapter 3 and in response to Research Question 1, we presented a collection of scientifically-motivated design principles in five themes and ten categories which assist a children's online social networking designer in making foundational decisions regarding

features and affordances. Our extensive literature search found, for example, that children should have the ability to choose their own names, to manage their own friendships, and to share multimedia artifacts with one another. We found that parents should make online supervision a routine exercise, that cartoon avatars lead to a deeper sense of community, and that measures employed to protect children from cyberthreats should be balanced in such a way that maximizes autonomy and expressiveness. This collection of design principles serves as a handbook of children's social networking design.

In Chapter 4 and in response to Research Question 2, we presented a summarized view of KidGab, our custom-built social network for children. We provided detailed descriptions of the system from the point of view of every stakeholder — child, parent, mentor, and administrator. We provide descriptions of our methods for moderating and monitoring our child users, gamifying the practice of appropriate social network posting, motivating users with personality quizzes and avatar customization, and administrating a site of KidGab's scope in such a way that it makes the endless amount of content creation quick and robust. Alongside the descriptions of KidGab, we provide usage statistics collected from 458 of deployment among 271 Girl Scouts in central Texas (and around the world, as several of our users have moved to other states including Iowa and California, and even other countries, including Japan and France). The usage statistics provide a general view of our user-population's interest in each affordance and how such interest differs between affordances.

In Chapter 6 and in response to Research Question 3, we presented a study on the

propensity of children to adopt and regurgitate the ideas of their peers. We found that priming children with examples of others' solutions to creative ideation activities resulted in an increased amount of conformity displayed, compared with similar ideation tasks without priming examples. We found that uniqueness increases with priming, indicating that children strive to be similar to their peers such that they fit in, but they also strive to maintain a unique position and identity within the community of peers (and of ideas). We found that social priming increased both conformity and influence for those who already have a tendency to conform, but among those who tend not to conform, the effect was opposite: social priming decreases both conformity and influence. We found that highly unique, highly conforming, and highly influential users display significant and differentiating online behavioral traits — highly unique users enjoy earning badges, highly conforming users choose activities which promote their visibility, and highly influential users are greatly motivated by quizzes but highly un-motivated by avatar-customization.

In chapter 7 and in response to Research Question 4, we presented an analysis of two of our social networking affordances: the gamified digital badge system and the silly personality quizzes. Through this analysis, we found that youth *say* they are most interested in identity exploration and self-reflecting in online contexts, they actually partake in activities which garner them more feedback — either real feedback from peers or artificial feedback from personality quiz results. Additionally, we found that conversations about identity tend to follow conformity and sameness of experience. Youth are more likely to communicate with one another if they know they share a common experience or clear-cut

differences/similarities.

In Chapter 8 and in response to Research Question 5, the capstone of this initial body of work regarding children's online social networking behaviors on a researcher-deployed network, discusses the lessons we learned whilst building and deploying KidGab. We explain that gamification of appropriate online posting is not a very strong motivator for online participation, but the introduction of a rewards component which leverages identity expression as a reward for participation is quite effective in procuring and maintaining longitudinal participation. Throughout our deployment we found that the median active time a girl spends on KidGab is a mere 6.0, but if we can engage a girl past four hours, the median time extends to 10.24 days. We found that fresh content needs to be released frequently in order to sustain an active community. We found that parents will intimate that they would like to be involved in their child(ren)'s online social networking behaviors, but that ultimately they will likely not act on that desire. Finally we found that the fitness of the server which hosts an online social network and the team which services it need to be robust and trustworthy or the data can suffer great losses in terms of participation and data collection.

Possibly the greatest contribution of this work lies in the sheer quantity of data collected throughout our deployments of KidGab. Prior to this research, no quantitative accounts of children's online social networking behaviors existed, let alone from the prospective of an ongoing and increasingly-rich deployment on an online social network designed and maintained by research staff. This body of work serves as a landmark in the space of ob-

served children's social networking. Our dataset (thus far) includes 13,704 total recorded wall posts, 1,841 sketches, 2,845 personality quiz and survey responses, and thousands more datapoints regarding friendships, communication networks, avatar choices, etc., each formed from 4,319 logins across 458 days of deployment. The data is so rich, we feel we have hardly scratched the surface of the possible research questions one might answer regarding online social networking for children. Even the stroke data from the sketched signatures collected upon online consent from the parents and the children could provide fascinating insight about child vs. adult digital signature styles.

In conclusion, this work provides a rich account of quantitatively evidenced online social networking for children. We designed and developed a system, deployed it for 458 days (and counting), incrementally improved it with new content and interaction affordances, and studied the resulting behaviors of the child users. Our results and experiences provide a strong foundation upon which an entire community of researchers can build.

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APPENDIX A

A MULTI-NATIONAL REVIEW OF MIDDLE SCHOOL CYBERBULLYING

A.1 Introduction

Electronic communication technology is becoming more widespread and ubiquitous with every fast-moving second of the twenty-first century. It has allowed the world to become an interconnected, global neighborhood never before seen in human history. While this allows our cultures to be enriched by the influence of others, it also provides an opportunity for bullies and harassers to do harm with very little effort or expense.

Cyberbullying is generally defined as: repeated exposure of a victim to harmful actions by one or more students with higher social or physical power than the victim [146]; where the harmful actions must take place on an electronic communication medium, including (but certainly not limited to) chatrooms, instant messaging applications, social networking sites, videos, online games, text messages, and blogs.

Many researchers have considered the prevalence of cyberbullying in many different countries and cultures [145, 154, 117]. The finding that that cyberbullying peaks around junior high age (11-13 years of age) seems to be the only thing that most researchers from different cultures agree on [210, 11, 184].

Reported cyberbullying victimization rates have been shown to vary between contexts and cultures. Some studies indicate rates as high as 36% victimization [73], and some

indicate as low as 9% [11]. Some researchers find males are more likely to be victims and others find that females are more likely to be victims. It has become clear that cyberbullying is not a static and universal phenomenon, but a force that is relative to the conditions and culture in which it occurs. This literature review endeavors to make sense of the scattered results of published studies by placing them in a multicultural & multinational perspective.

In this literature review, the following questions will be addressed:

1. Since cyberbullying victimization rates for middle school students appear to vary with culture, can any sense be made of the data when culture is examined alongside the results?
2. What characteristics about a person increase or decrease his or her chances of being cyberbullied? Are these universal characteristics?
3. Is there a cultural basis to findings that males or females are more likely to be victims of cyberbullying?

A.2 Selection Criteria

The following criteria ruled the selection of articles included in this review. First, the articles needed to be published in a peer-reviewed academic journal, written in either English or Spanish. Second, the article must report original data about the prevalence of cyberbullying (based on number of students involved) in a specific geographic area. Third, the researchers must have included middle school students (ages approximately 11-13) in the participant pool. Finally, a wide range of countries and cultures was necessary

to facilitate the multinational analysis presented in this paper, so of the set of papers from a given country, only the most recent (or most cited) was selected for membership to the set, unless the country was very large (e.g. USA and Canada), then different geographic regions within the country were allowed to be represented.

The literature search was performed between September 2012 and November 2012 in the following databases: Academic Search Complete (EBSCO), ERIC (EBSCO), PsycINFO 1872-current (ProQuest), ScienceDirect (Elsevier), and Web of Science (ISI).

A.3 Results

In sum, 15 articles were collected and analyzed, spanning 12 countries from 4 continents (North America, South America, Europe, and Asia). A summary of the gathered results can be seen in Figure A.1.

A.3.1 Does Cultural Structure Affect Cyberbullying Victimization?

Cultures can be categorized in many different ways, for example by the power differential in families, by the amount of context used in conversation, or by the underlying goals of a cultural member. Here, focus is placed on the last of these. Individualist cultures contain communities of people that place priority on individual outcomes while collectivist cultures are made up of people that place priority on group goals and successes [175].

When the gathered cyberbullying articles were categorized as individualistic vs. collectivistic cultures, the prevalence of victimization gave an unexpected result. The average prevalence of cyberbullying victimization in collectivistic cultures (Japan, China, Ser-

First Author	Country	Cultural Structure	% Total Victims	% Total Bullies	Who was Victim More?	Who was Bully More?
Li [117]	China	Collectivistic	33	7	N/S	N/S
Utsumi [202]	Japan	Collectivistic	25	26	N/S	N/S
Popović-Ćitić [154]	Serbia	Collectivistic	20	10	Male	Male
Huang [73]	Taiwan	Collectivistic	35.9	20.4	Male	Male
Yilmaz [218]	Turkey	Collectivistic	17.9	6.4	Male	Male
Mark [127]	USA, Hawaii	Collectivistic	25	6	Female	Female
Li [117]	Canada, Western	Individualistic	25	15	N/S	N/S
Cassidy [27]	Canada, British Columbia	Individualistic	35	25	N/S	N/S
Wade [210]	Canada, Midwestern	Individualistic	21.9	29.7	Female	N/S
Schultze-Krumbholz [179]	Germany	Individualistic	15.5	16.9	N/S	N/S
Oliveros [145]	Peru	Individualistic	20	10	Female	Male
Ortega [148]	Spain	Individualistic	13.6	17	N/S	N/S
Slonje [184]	Sweeden	Individualistic	17.6	11.9	N/S	Male
Ackers [3]	United Kingdom	Individualistic	11	7	Female	Male
Sengupta [180]	USA	Individualistic	25	N/S	Female	N/S
Bauman [11]	USA, Arizona	Individualistic	9	8	N/S	N/S

Table A.1: Summary of article findings. N/S stands for Not Specified. Cultural structure values determined from Santrock [175]

bia, Turkey, and Taiwan) is 26%, a number quite a bit higher than individualistic cultures (Canada, USA, Spain, Germany, and Peru) that have an average cyberbullying victimization prevalence of 19%. Huang and Chou (Taiwan) suggest that "[i]n collective societies, witnesses of bullying may refrain from intervening for fear of upsetting a sense of security and harmony, and victims might endure the sufferings to avoid conflicts with others" [73, p.1583].

Along similar lines, in a study of Ijime (Japanese bullying) in 1999, Maeda proposed that Japanese students were more likely than their Western counterparts to bully in indirect ways (e.g. rumor spreading) [123, 73]. This tendency was found to be strongly coupled with general social conformity. This implies that in individualistic societies, students may be more likely to engage in direct and physical bullying, may be more likely to report cyberbullying, or may be more likely to retaliate. Any of those explanations could reduce the likelihood of Western adolescents engaging in cyberbullying behavior.

Hwang and Francesco conducted a study in the USA regarding use of educational feedback channels by students that identify with more collectivistic or individualistic tendencies [75]. The researchers found that the collectivist students enjoyed online discussion boards and forums more than their individualist classmates. Though individualists were found to be less concerned with other students' opinions and more interested in their own needs, this did not correlate to increased discussion board activity. In fact, individualists were found to contribute considerably less than the collectivists, since collectivists would want to share their knowledge among the group. Individualists felt no such obligation [75].

This concept translates to the cyberbullying sphere, where collectivistic students tend to be cyberbullied more than their individualistic counterparts.

A.3.2 Generally Speaking, Who Is The Victim?

In a British-Columbian (Canadian) study of cyberbullying prevalence, Cassidy, Jackson, and Brown asked participants an open-ended question regarding the students that are most likely to be the victims of cyberbullying [27]. Cassidy et al. found that,

> "approximately 95 percent of both male and female respondents from all age ranges and across all represented ethnic backgrounds claimed that students are more likely to be cyberbullied because of specific attributes such as special needs, academic abilities, un-popularity, physical appearance, physical and mental disabilities, unfashionable clothing, and ethnicity" [27, p. 389].

Similar findings were reported from the United Kingdom, where Ackers found that a student's appearance, individuality (i.e. "emo, goth"), origin, or beliefs may make him or her more likely to be cyberbullied. There was also a trend indicating that a bully's jealousy of a student makes that student more of a target for cyberbullying [3]. The USA study by Sengupta and Chaudhuri also supports Cassidy et al.'s finding [180]. In the USA, black students were found to be 22% more likely to be cyberbullied and those of races other than black or white were 75% more likely to be cyberbullied. It was not mentioned by Sengupta et al. whether this cyberbullying was predominately interracial or intraracial. Interestingly, those students in the USA study that were involved in extra-curricular activities were 12% less likely to be cyberbullied [180].

In Taiwan, Huang & Chou researched the effect of academic achievement and its connection with cyberbullying victimization & perpetration [73]. Since Taiwan's culture values academic achievement in its young people highly, the researchers expected to find it to be a significant factor in cyberbullying victimization. What they found was that there was no significant data indicating a connection. Huang et al. stated,

> "The possible reason is that Taiwan society is more test-oriented than the United States or Canada owing to Taiwan's deep-rooted Confucianism [70].... This study's results indicate that academic performance affects neither daily relationships nor the harmony and balance of the class nor a certain group in regards to their cyberbullying experiences" [73, p.1586]

A.3.3 Gender Differences In Victimization: Is The Jury Still Out?

The selected articles present inconclusive results regarding the gender most involved in cyberbullying. Of the articles that reported gender differences in victimization, three reported that males were more likely to be cyberbullying victims: Taiwan [73], Turkey [218], and Serbia [154], while five of the selected articles reported that females were more likely to be victims: USA-Hawaii [127], USA [180], Canada-British Columbia [27], United Kingdom [3] and Peru [145]. It is interesting that these results fall into the aforementioned collectivistic vs. individualistic categories, which is not likely to be coincidental.

Popović-Ćitić et al., in their article regarding cyberbullying in Serbia, reasoned that,

> "[i]t may be assumed that certain elements of the cultural context influence the fact that girls are less likely to experience victimization, including the boys'

conviction that violence should not be manifested towards girls as they are a 'weaker' gender, and that they should be protected" [154, p. 420].

Huang & Chou attribute the finding that males cyberbully and are cyberbullied more often than females to the fact that males use technology more often than females [73]. In the Turkish study by Yilmaz (2011) , 20.5% of males were cyberbullied on a massively multiplayer online game (MMOG) but only 2.3% of females experienced the same treatment [218]. This may be because males are more likely than females to play MMOGs, but this was not investigated in the study.

To explain why females might cyberbully more than males, Mark and Ratliff [127] (Hawaii) reference a suggestion by Casey-Cannon et al. [26]: fitting in and socializing may be of higher priority to females than males. Thus, females in Hawaii using technology to facilitate those objectives would increase their probability of cyberbullying victimization. In British Colombia, Cassidy, Jackson, and Brown found that females in their sample use the internet 18% more often than males do per week [27]. Increased use and activity may increase the likelihood of becoming a cyberbullying victim. In the general USA study by Sengupta, Chaudhuri and Anoshua, female participants were found to be 63% more likely to create a social networking site (SNS) profile, which was shown to increase the likelihood of being a victim by 24.5% [180]. The increased likelihood of having a SNS profile is in keeping with the idea that fitting in and socializing is more important to females. The urge to fit in may not be as strong in collectivist cultures because collectivists already feel as if they belong to their communities, whereas individualists may feel as if they have to prove

that they belong.

A.3.4 Rural Communities and Socioeconomic Status

Some conditions have been shown to affect cyberbullying victimization in addition to gender or cultural context, such as socioeconomic status or belonging to a rural community. Only one paper of the selected set focused solely on rural students of low socioeconomic status [11]. This study was conducted in a poor rural middle school (grades 5 through 8) in southeastern Arizona. The prevalence of cyberbullying victimization (7%) is the lowest among all the studies and the rate of cyberbullying perpetration (8%) is the second-lowest of those considered in this analysis [11]. One explanation Bauman offers is that these students did not have equal access to the technology necessary to cyberbully, even more than poor students in an urban neighborhood [11]. Bauman's survey results showed that 60% of the participants have a home computer with internet access, 14% of participants had a computer with internet access in their bedrooms, and 48% had personal cell phones [11]. Bauman suggests that students in urban neighborhoods under similar socioeconomic conditions can often use computers for personal uses at public libraries or after school programs, but those facilities do not exist in the rural town where the participants lived [11]. She also suggests that this may be a good representative of "early stages of technology adoption by youth, and thus early stages of cyberbullying involvement, providing a window into this phenomenon with implications for prevention" [11, p. 929].

The Peruvian study conducted by Oliveros et al. compares cyberbullying results at public vs. private schools in Lima, the urban capital city of Peru [145]. The authors found

that the total number of students involved in cyberbullying in public schools, 21.0%, was significantly lower than the total number involved in private schools, 41.2%. The survey also showed that significantly fewer students in public school had computers in their homes (68.2% vs. 98.9%), computers in their bedrooms (24.3% vs. 36.2%), and personal cell phones (63.8% vs. 86.8%) (p. 14) [145]. Though these differences did not show correlating relationships between having the technology and cyberbullying, these results do support those found by Bauman.

A.4 Discussion

The conclusions found in this review are supported by sociocultural theory. The sociocultural theory suggests that bullying victimization and perpetration is dependent on the culture and social structure of the group in which it takes place. Roland and Galloway's research on traditional bullying in Norway found that the social structure of a classroom significantly affected the prevalence of bullying [164]. The primary school classes that were more democratic in nature tended to experience more bullying than others. These findings translate to the cyberbullying sphere as well, since we have found that children from individualistic cultures cyberbully less. This indicates that cyberbullying is not a universally equivalent phenomenon that should be investigated independently of culture. Cyberbullying is a product of culture. Thus, more research is needed to investigate the cultural impacts on cyberbullying around the world.

Future work is also needed in the fundamental experimental design of cyberbully-

ing studies. All fifteen of the studies in this literature review relied on questionnaires and self-reporting of cyberbullying events. Since cyberbullying occurs on a digital stage, these occurrences can be monitored and recorded as they happen, rather than a significant amount of time afterward. This would allow the study to be based on actual events, rather than only those events the students remember or agree to disclose to the researchers. Relationships need to be forged between educational researchers and computer scientists so that collaborative information retrieval and data analysis can help further research in the cyberbullying domain.

A.5 Conclusions & Contributions

In sum, this review has revealed 4 key findings (note that these are general findings and not definitive rules). First, across the world, victims of cyberbullying are chosen based on their personal characteristics, such as physical appearance, beliefs, origin, etc. Second, cyberbullying victimization is more prominent in collectivistic cultures. Third, males are more likely victims of cyberbullying in collectivistic societies and females are more likely cyberbullying victims in individualistic societies. Finally, cyberbullying victimization is less prominent in rural or low-socioeconomic regions. Educators and parents should be aware of the tendencies of cyberbullying victimization in their cultures and contexts and use that knowledge to protect their students from psychological devastation caused by cyberbullying victimization.

APPENDIX B

LEVERAGING WRITING STYLE ARTIFACTS TO PREDICT UNDISCLOSED DEMOGRAPHIC INFORMATION IN SOCIAL MEDIA DATASETS

In the past decade, a significant growth in social media participation has yielded very large datasets which, through machine learning, have the potential to provide rich information about users and user behavior in general. To make meaningful inferences from social media content, massive amounts of good quality, labelled data is necessary. However, a large percentage of data from social media is unusable or unreliable because of missing, or undisclosed or otherwise unavailable data labels. In our experience, more than eighty percent of posts in datasets of social media content is missing of one or more vital demographic labels such as age, gender, or date of birth [98]. Hartley et. al. indicated that 20% of their dataset had missing values [66].

Missing or inconsistent data is a known problem resulting from reasons ranging from procedural factors, blank or invalid user responses, and incompetence, to privacy and non-disclosure agreements [23]. Researchers have found ways of incorporating some of the unusable data through preprocessing, modeling and imputing statistically salient values to fill in missing-data [120]. These methods vary from simple statistics such as average, mode, or medial values, to more complex and elaborate methods such as maximum likelihood algorithms, or expectation maximization algorithms [66, 147, 177, 61].

Model-based algorithms such as maximum likelihood (ML) are designed to model observed data and make inferences based on model parameters. ML is flexible and avoids imputing missing values as is the case in imputation-based procedures such as mean imputation and regression imputation. This makes ML a more statistically neutral method that minimizes the negative impact of missing values on the overall dataset [120]. In general, while these procedures allow us to analyze datasets with significant quantities of missing data, they do not provide any added information to improve data understanding and interpretation. The reasons for this may be traced to the fact that these methods were developed for a different type of dataset (market prices, currency trade calculations, weather, voltage measurements etc.).

Data from social media offers the advantage that accurate inferences providing additional information about the data can be made from the data itself. This type of information-gathering has been applied by hundreds of researchers for opinion mining, sentiment analysis, user behavior modeling, linguistic analysis, recommending, etc. (i.e. [121, 212, 150, 15, 104, 46]).

Although the aforementioned systems can identify specific characteristics such as whether a person loves dogs or not [121], the focus on content is not especially helpful for identifying much more general demographic information, such as age, gender, or occupation. A single social networking post can be about one of billions of topics. Therefore, neither topic nor content information alone can distinguish classes within demographic categories given just one (or even a few) posts by any given author.

However, there are semantics within a social networking post that are more consistent across posts than topic. These stylistic semantics are often ignored or filtered out during preprocessing steps for most information retrieval systems — i.e. punctuation, misspellings, etc. Stylistic artifacts can identify *how* a person writes rather than *what* a person writes about. We think, and prior works confirm [152, 178, 49, 10] that the *how*, is much more identifying than the *what*.

This idea is very similar to the manner in which forensic scientists conduct identity verification through DNA analysis. The coding portions of individual DNA, which dictate hair color, height, etc. are disregarded, but non-coding portions, which appear to dictate nothing at all actually contain the truly identifying features. In this metaphor, the coding portions are synonymous with the content of the posts - the words, semantics, and meaning - while the non-coding portions are synonymous with the stylistic artifacts.

A few researchers have worked to identify stylistic differences in writing samples on social networks. For example, Schnoebelen studied the social networking behaviors of Twitter users who utilized nosed (e.g. ":-]") vs. nose-less (e.g. ":]") emoticons [178]. Schnoebelen found that people who use nose-less emoticons tend to follow younger celebrities, use more stylistic devices such as repeated letters (as in "cooooool!"), and misspell more words.

Pennebaker's LIWK system, can estimate levels of depression, "valley girl" tendencies, arrogance, personability, anger, and more based on the types of pronouns used, including: egocentric (i.e. I, me, my), self-inclusive (i.e. we, us, our), and self-exclusive

(i.e. you, y'all, yours) pronouns [152].

Caverlee and Webb investigated behavior of MySpace users and found that people of different age and gender exhibit different linguistic characteristics when describing themselves in the "About me" and other similar sections on their profile pages [28]. They analyzed word choice and found class-specific terms popular among different genders and several ages (18, 25, 40 etc.). (It is important to note that word choice is a stylistic artifact while topic choice is an artifact of content.)

As seen by the example works of Schnoebelen, Pennebaker, and Caverlee and Webb, features of style can provide a fascinating insight into personality and identity. We believe we can leverage these ideas (and some ideas of our own) to solve the aforementioned problem of sparsity of demographic data in social networking datasets.

B.1 Hypotheses

In this work, we investigate stylistic artifacts of social networking posts including: the use of punctuation, capital letters, and emoticons [178]; pronoun use [152]; and vocabulary development and word choice [28, 49, 10]. We use a validated portion of a social networking corpus and a set of style-based features to build classifiers for predicting missing demographic data in social networking datasets. We claim that the classifiers thus generated can predict, with a high degree of accuracy, crucial values missing in the larger dataset. Using these methods, we test the following hypotheses:

1. Can stylistic features extracted from social media posts significantly differentiate

Gender Total Posts: 146994	**Male** 81913 (56%)	**Female** 65081 (44%)				
AgeRange Total Posts: 142144	**16 to 24** 51968 (37%)	**25 to 39** 61594 (43%)	**40 to 54** 9721 (7%)	**55 to 68** 1793 (1%)	**69+** 17068 (12%)	
BirthMonth Total Posts: 133715	**January** 10824 (8%)	**February** 11632 (9%)	**March** 9498 (7%)	**April** 12156 (9%)	**May** 11329 (8%)	**June** 9774 (7%)
	July 10684 (8%)	**August** 10718 (8%)	**September** 12589 (9%)	**October** 10893 (8%)	**November** 12061 (9%)	**December** 11557 (9%)
BirthSeason Total Posts: 133715	**Spring** 33259 (25%)	**Summer** 34511 (26%)	**Autumn** 31954 (24%)	**Winter** 33991 (25%)		
ZodiacElement Total Posts: 133715	**Earth** 33570 (25%)	**Air** 33715 (25%)	**Fire** 31316 (24%)	**Water** 35114 (26%)		

Table B.1: Demographic categories, the classes within those categories, and the number of posts in our dataset for each class.

between ages, genders, and birth months?

2. Which classifiers perform best for our stylistic features?

3. Is our method of predicting demographic data more accurate than traditional statistical methods?

B.2 Method

B.2.1 Dataset and Preprocessing

To build our style-based classifiers, we used a large dataset of MySpace profiles collected in the summer of 2010, including profiles and user 'wall' posts for 127,974 MySpace users [98]. This dataset included 2.6 million posts, but because we are interested in the author of the post, and not the owner of the wall on which the post was written, we were able to use only 339,641 of the 2.6 million. Because users choose whether to disclose demographic information on their profiles, the posts may or may not not be labeled with information regarding age, gender, hometown, current city, zodiac sign, occupation, etc. The 43,198 authors in our dataset (authors for which we have at least one writing sample) were 56% male, had birth months evenly spread across the year, and self-reported ages

between 16 and 110 (clearly, some age information in the dataset was falsified). More detailed information regarding the demographic makeup of the dataset can be found in Table B.1.

Authors with more than 100 posts in our dataset were investigated by our research team to determine if the posts were majority spam. If found to be spam, all posts by that author were removed from the dataset.

B.2.2 Demographic Categories

As mentioned above, this work strives to identify stylistic differences in online communication across demographic groups. The demographics we are particularly interested in are gender, age, and month of birth. We chose to add *season of birth* to our demographic category list as a generalization of birth month. The effect of the season of birth on behavior (such as temperament) and maturity is significant and has been widely accepted by the scientific community (e.g. [29, 45]). Finally, we chose to add a wildcard to our list of demographic categories: *zodiac elements*. The zodiac element is a construct in astrology where people born in specific months are grouped into categories (such as earth and fire). Previous studies indicate that people within zodiac elements exhibit similar behavioral characteristics (such as introversion and extraversion [129, 189]). We included the wildcard because we believe if we can correctly classify demographic information as obscure as a user's zodiac element, we can show that our methods can be used for predicting a wide range of obscure demographic categories better than traditional statistical methods.

The classes within each demographic category can be seen in Table B.1. The gender

classes (male and female) were those provided to us by the dataset. We empirically grouped ages into five classes in such a way that avoids over-representation of posts in any one category and also, we believe, splits along appropriate developmental and life stages. The '69+' age range was defined to encapsulate the age-falsification mentioned above. Because our dataset did not provide date-of-birth information but did provide authors' zodiac signs, we assigned each author his or her month of birth based on the month whose first day exists within the bounds of their reported sign (e.g. if the author reported Pisces, we assigned March, because March 1 falls within Pisces). The birth seasons are based upon the months of each North American season (e.g. April, May, and June represent Spring signs). The zodiac element classes are those provided by traditional Western astrology.

B.2.3 Features of Style

The set of features we developed (many of which are novel) to discern between genders, ages, and times of birth capture the *style* in which an author composed a post, rather than the *content* of the post.

We designed a set of 80 features in three themes to identify stylistic differences of online authors: simplicity scores, word types, and characters and symbols. In our tokenization scheme, tokens are simply contiguous non-space characters. We do not strip or remove punctuation.

Most of our 80 features involve some form of occurrence-counting. To normalize each count, we divide the it by the number of tokens in the post (unless otherwise noted). Both the total counts and the normalized counts are included as features. Features novel to

this work are marked with an asterisk (*).

Simplicity Score Features

We processed our entire dataset of 2.6 million posts to find the 5,000 most-frequently-used words. The first most-frequent word, 'you', has a score of 1, and the last of our most-frequent words, 'mountains', has a score of 2903 (ties in frequency were allowed). Words not included in our most-frequent words dictionary received a score of 3000. We sum the total score over all words in the post to find the total word-novelty score*.

Our Scrabble score* features are defined by the rules of the popular word game Scrabble. In this game, common letters such as A, E, T, S, R, etc. receive a score of 1, while more uncommon letters, such as Q and Z, receive higher scores. We sum the Scrabble scores for each word in the post. Additionally, we record the highest scoring individual word.

Types-of-Word Features

Every feature in the Types-of-Word theme is a count of a particular type of word. We describe our collection of dictionaries below.

Pronouns. Pennebaker [152] employs three classes of pronouns: egocentric (I, me, my, mine, etc.), self-exclusive (he, she, you, his, hers, your, etc.), and self-inclusive (we, us, ours, etc.).

Age & Gendered Words. Caverlee and Webb [28] reported the 16 most-frequent unique words used by males and females and the ten most-frequent words used by people of ages 16, 18, 20, 25, 30, 40, 60, and 69 on MySpace.

Slang & Swear Words. We scraped *UrbanDictionary*[1] to generate a dictionary of 3,540 of the most popular slang words. Additionally, we acquired a list of swearwords from the *Swear Word List, Dictionary, Filter, and API* [2]. We also defined a list of common netspeak words (e.g. lol, omg, brb, haha, xoxo).

Misspelled Words. To find misspelled words, our program utilizes a spell-checker developed by Norvig[3]. Because people often use different orthographic devices in online text [156], particularly the repetition of letters ('looove', for example), we chose to detect this type of misspelling as a feature.

Hyperlinks. Hyperlinks were a special class of words initially identified to speed up the spellchecking process, but we found that the total number of hyperlinks and normalized number of hyperlinks are quite useful as features.

Capitalization. In our personal experience, we have noticed differences in the use of capitalization by people of different ages, genders, and personality types. For this reason, we count the number of all-caps words* (e.g. "BEAUTIFUL") and sentence-case words* (e.g. "Beautiful") in each post.

Character and Symbol Features

We count the total number of alphabetic and non-alphabetic characters. We also include the average number of characters per word (total word length) and average alphabetic characters per word (alphabetic word length) as character features.

[1] http://www.UrbanDictionary.com
[2] http://www.noswearing.com/dictionary
[3] http://norvig.com/spell-correct.html

We hypothesized that the use of punctuation and symbols would tend to vary with age, since more punctuation becomes required as sentences become more complex. To test this hypothesis, we count the number of commas*, ellipses*, and exclamation points* used in each post. Similarly, we find the average number of symbols per word, which helps identify over-use of punctuation, such as "Hi!!!!". We also collect the number of non-alphabetic words (such as a number or emoticon).

As mentioned above, Schnoebelen [178] found that the way a person uses emoticons varies with age. To test this theory, we include a feature for all emoticons, as well as individual counts for nosed, noseless, and a third type of emoticons, which we have named 'anime emoticons'* (such as o_O, ^-^, etc.).

B.2.4 Dimensionality Reduction & Single-Post Classification

For all of the 339,641 individual posts in our modified dataset, we calculated the features mentioned above. The feature values for all posts make up our 'entire' dataset. Additionally, we randomly generated 'train' and 'test' sets from our entire set, with each post having a 20% probability of falling into the test set.

Because our original feature count (80) was high (and thus expensive to compute), we performed dimensionality reduction for each of the classification categories using our train set (we omitted the test set samples in this step to ensure validity of our classification results). We used a genetic search algorithm which used a simple entropy-based subset evaluator as the fitness function [64]. We performed this genetic search for each classification category with ten-fold cross-validation. We removed any features not selected by any

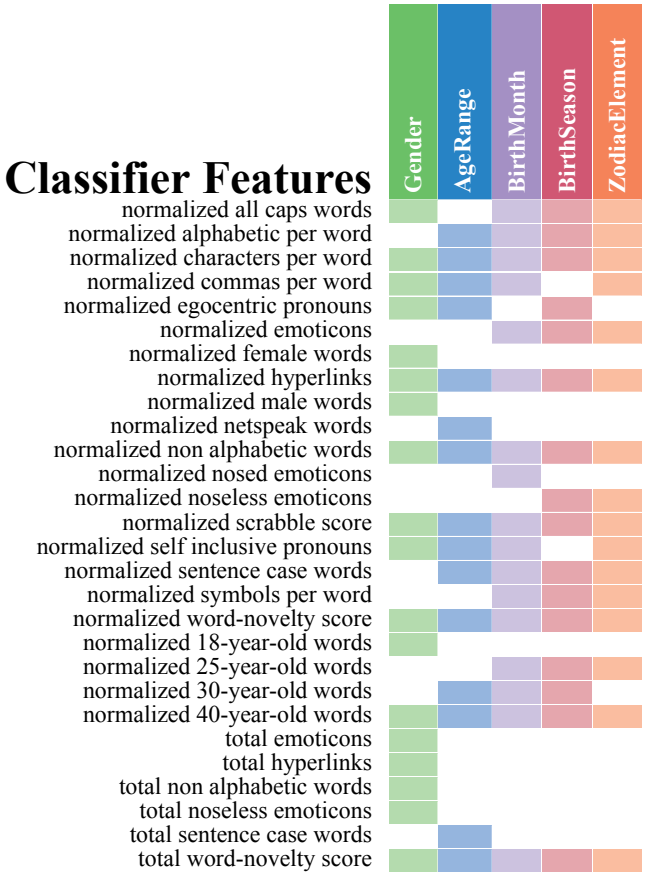

Table B.2: Features chosen for each demographic category after dimensionality reduction.

of the ten folds and performed the genetic search again on the smaller set of features. The features chosen to be included in the pseudo-optimal subset were those which appeared in more than half of the ten folds in the second round of genetic search. The final feature sets are displayed in Table B.2.

With each of our pseudo-optimal feature sets, we created five classic classifiers: a Linear classifier[4], a Bayesian network[5], a Multi-Layer Perceptron[6], a decision tree[7], and a

[4]WEKA classifier: LibLinear
[5]WEKA classifier: BayesNet $\alpha = .5$
[6]WEKA classifier: MultilayerPerceptron
[7]WEKA classifier: REPTree

F-Measures and True-Positive Rates (in parenthesis) of Single-Post Classification Accuracy of Train/Test Sets

	Random	Majority	Maximum Likelihood	Decision Tree	SVM
Gender	.500 (50%)	.396 (55%)	.691 (70%)	**.706 (71%)**	.690 (70%)
AgeRange	.200 (20%)	.259 (43%)	.489 (51%)	.619 (62%)	**.626 (63%)**
Birth Month	.083 (8%)	.016 (9%)	.198 (20%)	.354 (35%)	**.408 (39%)**
BirthSeason	.250 (25%)	.106 (26%)	.357 (38%)	.484 (48%)	**.507 (51%)**
ZodiacElement	.250 (25%)	.108 (26%)	.343 (34%)	.479 (49%)	**.504 (50%)**

F-Measures and True-Positive Rates (in parenthesis) of Single-Post Classification Accuracy of Entire Set With 10-fold Cross Validation

Gender	.500 (50%)	.399 (56%)	.690 (69%)	**.712 (70%)**	.710 (71%)
AgeRange	.200 (20%)	.262 (43%)	.485 (51%)	**.632 (64%)**	.620 (62%)
BirthMonth	.083 (8%)	.016 (9%)	.200 (21%)	.361 (36%)	**.410 (40%)**
BirthSeason	.250 (25%)	.106 (26%)	.356 (36%)	.489 (49%)	**.514 (51%)**
ZodiacElement	.250 (25%)	.109 (26%)	.344 (34%)	.481 (48%)	**.508 (51%)**

Table B.3: Classification accuracies. F-Measures and TP rates (in parenthesis) of our single-post classifiers for each demographic category.

Support Vector Machine[8] using WEKA [64].

Specifically, for each demographic category, we created the five classifiers using ten-fold cross-validation on our entire dataset. Next, we created five more classifiers with just the train set and tested using the test set. All of these classifiers are termed *single-post classifiers* because they attempt to classify demographic information with the information contained within a single post.

Additionally, we compare our results with three traditional statistical methods for filling in missing data: random chance, majority classification rule[9], and maximum likelihood estimation[10]. To build each of the comparison classifiers, we used the sparsely-labeled demographic features provided by our dataset: Age, Gender, RelationshipStatus, SexualOrientation, Height, BodyType, ZodiacSign, and EducationLevel to predict the desired demographic information.

[8]WEKA classifier: LibSVM
[9]WEKA classifier: ZeroR
[10]WEKA classifier: BayesNet $\alpha = 0$

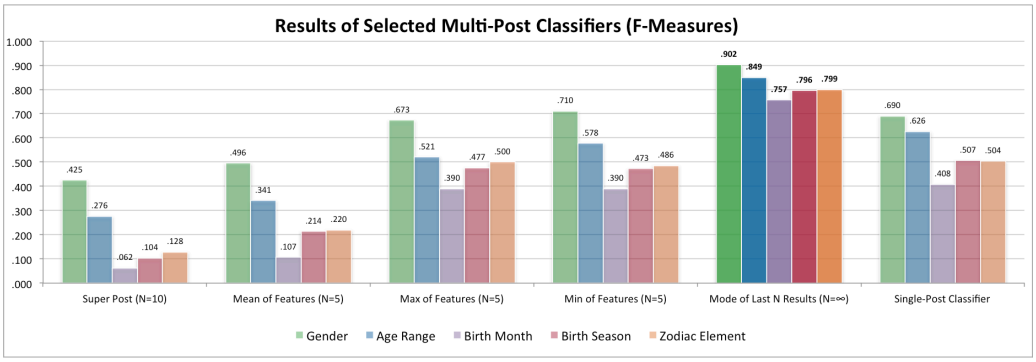

Figure B.1: Classification accuracies for the best-performing multi-post classifiers. F-Measures printed above each bar.

B.2.5 Author Modeling & Multi-Post Classification

The classifiers built using the above-described methodology classify demographic information about a person using a single post as a writing sample. Because our data contains an average of 7.9 posts per author, we tried several user modeling techniques to improve our classification results.

To accomplish this, we employed a model of an author which contained the text, features, and raw classification results of all previously identified posts. The first post encountered for a particular author has a model containing only data related to that post. However, the second post encountered by the same author will utilize both data from the second post and the first post. Therefore the classification of the n^{th} post for any author may utilize data from all prior posts (1, 2,...., n).

We recognize that storing text, features, and classification results can incur high memory costs, but we chose to keep track of all three pieces of data in order to learn which data points are most important for effective author modeling.

With this author model, we tested numerous methods of improving previous classification results. We call these methods *multi-post classifiers*. Each multi-post classifier also uses a single-post classifier in some way. To simplify our results, we used only one single-post classifier per demographic category, the SVM built by the training set. We chose the SVMs because they performed best in the majority of our demographic categories. We chose the SVMs created by the training set (and not the full corpus) so we could test our multi-post classifiers on data the single-post classifiers had not yet seen.

We designed and tested several multi-post classifiers:

Superpost-of-Last-N-Posts This multi-post classifier concatenates the last N posts into a 'superpost' (where N=5, 10, ∞). It then calculates feature information for the superpost, runs the superpost's features through the single-post classifier, and returns the classification result.

Mean-of-Last-N-Posts'-Features This multi-post classifier averages the features of the last N posts and returns the result of sending the modified feature set into the single-post classifier (N=5, 10, ∞).

Decaying-Mean-of-Last-N-Posts'-Features This behaves just as the Mean-of-Last-N-Posts'-Features, except that the value added by older posts decays by a certain amount each time a new post arrives (N=5, 10, ∞; initialRate=.5, .1; decayRate=.05, .005, 0).

Min/Max-of-Last-N-Posts'-Features Rather than sending the raw features through the single-post classifiers, this multi-post classifier sends the minimum (or maximum) values of each feature in the last N posts (where N=5, 10, ∞) through the single-post classifier

and returns the result.

Mode-of-Last-N-Results Rather than returning the raw classification result from the single-post classifier, we return the mode of the last N raw classification results (where N=5, 10, ∞). So if a user's current post recognizes as 'Male' but the previous 5 classifications for that user (including the current post) are {'Female', 'Female', 'Male', 'Female', 'Male'}, this multi-post classifier will return 'Female'.

To test the multi-post classifiers described above, we ran each of the posts in our test set through each of our author-model-enriched, multi-post classifiers. We recorded f-measures and true-positive rates of each classifier's performance over all posts (overall performance), as well as over the final post by each author (eventual performance).

B.3 Results and Discussion

We use f-measures and true-positive rates for statistical analysis of accuracy for each classifier. The f-measure for a classifier captures the harmonic mean of precision and recall, thus providing a balanced assessment of performance on true positives and false negatives.

B.3.1 Single-Post Classifiers

Accuracy scores for each of our single-post classifiers can be found in Table B.3. As seen in Table B.3, all of our classifiers performed well above the comparison techniques (the three traditional methods: random chance, majority classification rule, and maximum likelihood) for each category.

In most cases, the SVMs performed best, though only slightly better than the deci-

sion tree classifiers. We tested several more 'boutique' classifiers and were able to find uniformly superior results to the SVMs with the RandomForest classifier [21, 64] (e.g. f-measure for entire dataset, BirthMonth category = .736 vs .710 with SVM). We have chosen to report only the results of the most classic classifiers in this paper, however, for clarity and as proof that the intricacies we report in our data are real and correct, not just the random-chance result of finding a 'boutique' classifier capable of fitting our data.

B.3.2 Multi-Post Classifiers

Figure B.1 shows selected results (f-measures) of our multi-post classifiers on the last post by authors with ten or more posts. The omitted multi-post classifiers (other values of N, decaying weighted averages, etc.) performed more poorly than those provided. As seen in Figure B.1, classification results improved for only one of our user-modeling methods: the Mode-of-Last-N-Results method. Though this method was the simplest, results improved over the single-post classifier statistics for all values of N (5, 10, ∞) and increased as N increased. This is an advantageous result in terms of memory efficiency, since this method requires only the previous N recognition results and no feature vectors or text strings.

In summary, the results of our multi-post classifiers (particularly our Mode-of-Last-∞-Results classifier) show that we can classify:

- an author's gender with an f-measure of .902 and a true positive rate of 95% where maximum likelihood (ML) predicts an f-measure of only .690,
- the range of an author's age with an f-measure of .849 compared to .485 from ML,

- an author's birth month with an f-measure of .757 compared to .200 from ML,
- and an author's birth season with an f-measure of .796 compared to .356 from ML,
- an author's zodiac element with an f-measure of .799 compared to .344 from ML.

Herein lies evidence of the most significant contribution of this work — that by leveraging the use of often-ignored stylistic artifacts of social networking posts, even obscure demographic information (like the a person's zodiac element) can be identified with high accuracy. Our features include those that distinguish maturity, personality, and uniqueness, but in other domains, appropriate features will vary. These results meet our goals of identifying falsified (or otherwise missing) information on social networking or chat room data, as well as provide the wider contribution of presenting a method to more accurately estimate demographic data in sparse datasets of any kind.

A marked advantage of our methods over traditional statistical methods is that demographic data can be estimated using our classifiers without any other demographic data present. With statistical models such as ML, at least some demographic data is required to make any inference on missing values. Our methods do not require the presence of any demographic data, rather they glean features from the social media post itself.

In the next section, we will discuss the significance of our chosen features on our dataset.

B.3.3 Feature Significance

Significant Gender Differences

On average, female-authored posts had significantly lower word-novelty scores in comparison with their male counterparts ($p < .001$, where the null hypothesis is that there was no difference between classes). In fact, the average normalized word-novelty score for females (781) was over a 100 points lower than the average for males (892), which implies that males use more uncommon words than females.

Pronoun usage varied between genders: females used significantly more egocentric pronouns ($p < .001$), while males used more self-inclusive pronouns ($p < .001$). Males write words in all capital letters ($p < .005$) and use emoticons ($p < .001$) more frequently than do females. Females, on the other hand, use more than five times as many commas on average than males ($p < .001$).

Significant Age Differences

We found that authors in the '16 to 24' age group generally received lower word-novelty and Scrabble scores than older authors ($p < .01$). Also predictably, the '16 to 24' age group used more than double the netspeak words (on average) than every other group ($p < .001$).

The '16 to 24' age group used significantly more egocentric pronouns than any other group ($p < .001$), while self-inclusive pronouns were employed more by those in the '69+' or '40 to 54' classes ($p < .001$). Sentence-case words were used with similar frequency within the '16 to 24', '25 to 39', and '69+' classes, but were used significantly less than

the other categories ($p < .001$). To our surprise, commas were used significantly less by the '69+' and '40 to 54' categories than by any other ($p < .05$).

Significant Month, Season, and Element Differences

Birth Month. In terms of normalized word-novelty scores, authors born in August and September scored highest, while November- and June-born authors scored lowest ($p < .01$). Posts made by June- and September-borns earned the lowest Scrabble scores, while July- and March-borns scored highest ($p < .05$). February- and September-borns use more all-caps words than any other month ($p < .05$). September-, March-, and August-born authors employ more sentence-case words than those born in other months ($p < .05$) (particularly more than December-born authors, who use significantly fewer than all other months ($p < .001$)). March- and January-born authors utilize more emoticons in their posts than authors of any other month ($p < .05$). May- and September-born authors use a higher number of symbols per word ($p < .05$), while April- and September-born authors use more commas ($p < .05$). July-, August-, and October-borns use more family-oriented words (words defined by [28] to be common among 30-year-olds, such as 'parent,' 'proud,' and 'travel') , while December-borns used significantly fewer ($p < .05$).

Birth Season. As predicted, birth seasons offer a layer of abstraction above birth months, and many trends from birth months carry over into the seasons. For example, those born in the summer (Summers) use longer words ($p < .001$) and earn higher word-novelty scores ($p < .001$) on average than those born in any other season, which reflects the results above. Autumns earn lower word-novelty scores than those born in any other

season ($p < .05$). Winters use fewer egocentric pronouns ($p < .001$) while Springs use fewer all-caps words ($p < .001$).

Zodiac Element. Earth authors (January-, May-, and September-borns) earn total and normalized word-novelty scores higher than any other element, while Air authors (February-, June-, and October-borns) and Water authors (March, July, November-borns) earn significantly lower scores ($p < .05$). Fire authors (April-, August-, and December-born) use more self-inclusive pronouns ($p < .05$) and Air authors use fewer sentence-case words ($p < .05$).

B.4 Discussion

B.4.1 Gender Effects

There has been much research into the differing communication styles of men and women (most famously [106] and [197]). In the famous *Language and Woman's Place*, Lakoff asserts that women tend to insert more polite, meaningless, and neutral words into their speech patterns than men [106]. This trait may explain why female word-novelty scores are significantly lower than the male scores.

A recent study on teenage texting behaviors found that women use punctuation very differently in text messages than do men [119]. When texting, women omit punctuation to communicate negative feelings but use abundant punctuation to indicate a happy mood. Men do not use the subtle inclusion of grammatical punctuation to communicate emotion [119]. This conscious literary device by women could account for the five-fold increase in

comma usage between women and men.

Though men do not dabble in grammatical punctuation games, they do use punctuation to communicate emotion in the form of emoticons. It has been well-studied that men tend to struggle with communicating emotions verbally (e.g. [100]), which may explain why they employ more emotive artifacts such as emoticons than women.

B.4.2 Age Effects

We found that older age groups (40-54, 55-68) tend to use more sentence case words than the other age groups. This may be a reflection of the difference in keyboarding courses between the age groups. According to [115], keyboarding courses used to be generally taught in high school or later as a preparation for entering the workforce. As such, proper technique for capitalization (which has already been ingrained into the grammatical maturity of the high schooler) is habitually maintained on the keyboard [115]. Contrastingly, the age that users first learn touch-typing has been growing ever-younger and can now occur as young as kindergarten (but is usually about grade 3) [113]. The courses teaching keyboarding in more recent generations are also generally gamified [113], and may not stress the importance of proper capitalization while typing. Likewise, the time spent by younger generations practicing formal vs. informal keyboarding is skewed in favor of the informal (social media use), which may contribute to the informality of younger authors' posts.

The 40-54 and 69+ age groups exhibited more self-inclusive pronouns than the younger age groups. Pennebaker has shown that people of higher status and power (40-54

year-olds tend to be in positions of power both at work and in the home) tend to use more self-inclusive pronouns like “we” [152]. Another anecdotal consideration is that those in mature committed relationships tend to use “we” in place of “I” when storytelling (e.g. “we went...,” “we saw...,” “when we moved...,” etc). This (anecdotal) evidence may also account for the greater instances of self-inclusive pronouns among the 40-54 and 69+ age groups.

B.4.3 Birth-Related Effects

Though published literature relating to birth-related effects on personality have been greatly contested, some evidence exists with high significance that people born in specific months and seasons of the year have greater tendencies toward certain behaviors. Very little scientific evidence exists to encourage the existence of zodiac elements, so here we focus on birth month and season. Given space concerns, we illustrate only a few examples.

One such example is that March-born people tend to have higher neuroticism (emotionality) scores than those born in other months [130]. Our study found those born in March to exhibit higher use of emoticons, a possible outlet for the increased emotions. Another month known to produce people scoring highly in neuroticism is July [130, 190]. We found both March- and July-born people to have higher scrabble scores than those born in any other month. This increase in word complexity may be another device for emotional expression.

October-born people have been found to be more extroverted than those born in other months, which may explain their tendency to share posts about travel, family, etc. [130].

Those born in Autumn months tend to have more laid back personalities (they have lower tendencies toward depressive and anxious feelings) [161]. We found that Autumn-borns earn lower word-novelty scores than any other season, which may be evidence of a laid back communication style, unpressured to use an extensive vocabulary.

B.5 Conclusions & Contributions

Social media research requires a massive amount of good-quality, labelled data to draw accurate inferences. The Achilles heel of large social media datasets is missing-data for crucial information about authors. In this work, we present a unique method that does forensic analysis on the stylistic artifacts of social media posts to predict vital information about the post's author. Our method is able to predict, with a high level of accuracy, undisclosed or otherwise unavailable information such as race, education, gender, age, season and month of birth by utilizing a small subset of an accurately-labeled portion of the larger dataset.

In future work, we will test the ability of our system to detect predatory behavior such as cyberbullying and impersonation. In addition, we wish to explore how accurately our predictive models extend to future behavior such as future occupation, empathy level, ideological affiliation etc.